THE ULCER SYNDROME IN TROPICAL AFRICA.

M.D. 1935

INTRODUCTORY.

A considerable proportion of the native population of East Africa, in some cases due to injury, in others spontaneously, is constantly incapacitated by cutaneous ulceration. The marked degree of resistance to local treatment often encountered, the class distribution, and the fact that the same subject may suffer repeatedly, suggests that this condition presents an economic problem well worthy of attention.

Literature on this subject seems to deal chiefly with forms of treatment which in most instances are strictly local. Doubtless there is an ideal local treatment, but this ideal varies with the observer; it is felt that a local treatment which aims at the relief of congestion and oedema, the prevention of undue fibrosis, and simple antisepsis, can be carried out by many different methods. Local measures, thus, do not merit undue discussion.

Much seems to have been written on the efficiency of salvarsan substitutes, and antimony. If these remedies are so successful, it seems to indicate that the ulcers are specific, granulomatous, or/

or a sore such as might result from Leishmania tropica infection. It must be admitted that ulcers in Uganda rarely escape being classified as gummata, or yaws, because syphilis especially, and to a lesser extent yaws, figure largely in hospital and dispensary returns, and the percentage of positive sera in many districts is high.

The native considers many symptoms, no matter how varied, to indicate syphilis. He, or she, is nearly always found to have a craving for intravenous injections, often to such an extent as to indicate a complex, and outpatients nearly always glibly state that, having had "syphilis" in childhood, they now find themselves with chest pain, bone pains, ulcers, and other vague conditions and that an injection would clear these up. Under the circumstances it is understandable why the diagnosis of tertiary syphilis is so often made, and many an ulcer classed accordingly. Unfortunately, however, it is the rule to find many an ulcer treated by numerous injections of arsenical or antimony preparations, and after the loss of much time it is found that little benefit has resulted. In the experience of the writer, after six years of work on ulcers, a gumma or yaw, although often/

often undoubtedly resembling the usual ulcer, rapidly responds to specific therapy, often sufficiently quickly to be of diagnostic significance.

A certain amount has been written on the subject of measurement of ulcers, to gauge progress, and various calculations have been employed. It is doubtful if this conveys much in the end. Actually it is not difficult to judge whether an ulcer is "skinning-over" better than at a previous date - more so as in many cases no skinning occurs, but after certain measures have been adopted, a growing edge appears, ergo these measures have been responsible for such progress. The means of measurement usually adopted in this investigation are relatively simple. A dark skin regenerates as a greyish-pink pellicle. As it advances over the base of an ulcer, the edge remains with such a colour, but the older regenerated skin becomes pink and opaque, and later becomes pigmented. The edge then shows, from within outwards, a zone of greyish-pink pellicle, a band of pink, and outside this the skin is pigmented. The size of the base is ignored, as is the advancing edge, but the pink strip is noted as to its distance from the centre.

An attempt will be made to consider the subject/

subject from certain viewpoints, and it is hoped that it will be shewn to amount to far more than local treatment. A field-worker cannot be expected to be a biochemist, dietitian, or bacteriologist, and in the colonies he must depend largely on clinical observation. The laboratory service, small as it mostly is, finds the day fully occupied with routine work, and special investigations are not always possible. The laboratory worker and the medical officer usually find that a day is only a matter of twenty-four hours, and so it is only hoped to present features which other workers might consider worthy of investigation given time and opportunity.

1929 was devoted to finding a reasonably useful local treatment, investigation of flora in the hope of finding a causal organism, and the exclusion of C. diphtheriae, and thus veldt sore, this condition being then under suspicion. Internal medication was also investigated, and this led to arsenical preparations being largely discarded, whilst oral parathyroid and calcium were administered, as previous experience of this in the treatment of kindred conditions had not been without success in the hands of others. The efficacy of this in Uganda

was/

was encouraging, but further supplies were not forthcoming during 1930, which was devoted to further bacteriological investigation.

In 1931, certain work was attempted in Edinburgh, chiefly concerning the bacteriology of Ulcus tropicum. 1932, 1933, and 1934 were devoted to further work on parathyroid and calcium, whilst a number of sera were examined for calcium and phosphorus values; an attempt was also made to investigate the dietary of the Uganda native, with the idea of finding some relationship between this and parathyroid and/or calcium deficiency. Owing to the unreliability of the average uneducated native's statements as regards his dietary, very few figures on diet could be obtained, and, apart from a single analysis of certain articles of diet known to be staple articles, little could be achieved. As salt content, and other factors, vary greatly in every square mile of soil, this subject would probably require the attention of a large commission, with ample spare time and financial backing.

A native, on admission to hospital and questioned about his diet, will state that he eats meat several times a week, and that he has an unlimited supply of beans and ground-nuts; actually one knows/

knows that meat is seldom purchased by the "ulcer" class, and that probably only plantains and sweet potatoes are eaten. Considerable despondency and little information is thus the lot of the searcher after the truth.

A brief description of the clinical features, and treatment, of ulcers would not come amiss, and this is dealt with before the consideration of certain etiological factors, as the latter is lengthy.

CLINICAL FEATURES.

It is difficult to determine what should be classed as an ulcer, and what should not. Actually, it may be necessary to class as an ulcer what looks little more than an abrasion, and thus an ulcer may vary in size from an open pustule to a necrosis involving a considerable part of a leg. In Uganda, if an abrasion does not heal by first intention, and should it remain denuded of skin for any length of time, it must needs fall into the category of ulcer, because spontaneous healing is then infrequent in the case of the usual type of patient met with in hospital practice.

As so many agencies may bring about ulceration, which conforms to certain types, it is necessary to consider all types; the definite type known as Ulcus tropicum, or tropical phagoedena is thus not the only type which calls for consideration.

Ulcers in Uganda may be relegated to three groups, and, for convenience, these may be designated A, B, and C.

TYPE/

Fig. 1

Two examples of Class A multiple ulcers. Although the appearance is suggestive, they are non-treponematous. The case on the right shews less reaction.

Fig. 2

Two examples of larger Class A ulcers of long duration. The figure on left shews smaller ulcers also. The case on the right has had a certain amount of local treatment. Note the light (pink) strip which is easy to measure (advancing pellicle not seen). Case on left requires scraping and elastic pressure. Case on right requires bone chiselling.

TYPE A.

This corresponds to many of the usual lesions met with in European practice. As they are likely to be of long duration in the poorer class of native, the origin is either unknown or forgotten. Some arise as the result of an injury, trivial e.g. a scratch from a reed, or more noticeable, e.g. a cut or blow. Insect bites may be responsible, and it is of note that the bites of Simuliidae often result in small ulcers of extreme chronicity. Ulcers following the activities of Tunga penetrans usually do not fall into this group, as they frequently seem to become phagoedenic, and thus more often fall into class C.

Yaws, and tertiary syphilides, may present characters allowing of their being classified as "A", but only in certain instances has this been done, as specific therapy, more often than not, clears up the lesion without the necessity for other measures. For this reason, they are usually dealt with in the proper department. It is usually fairly easy to pick out specific lesions from the usual mixture of ulcers, as they often have a typical appearance. In cases of doubt, a special opinion is obtained. Only those/

those specific lesions which have become well-established as an "A"-like ulcer are considered here. It is hardly necessary to state that an ulcer, arising some weeks previously, and in association with secondary yaws, does not usually present difficulty in diagnosis. Varicose ulcers are not considered in this class - they are surgical.

The characters of ulcers of type A, of some duration, are indolence, a tendency to fibrosis, and "rolling" of the edge. Some wander at some points, healing spontaneously, but half-heartedly at others. The base varies. If fibrosis has not occurred to an excessive degree, the base appears a fairly healthy red, mesodermal reaction thus being good. If fibrosis has occurred, then, of course, the base is pale and "waxy". These ulcers take a surprisingly long time to heal, and often give rise to deformities, such as a depression, or a furrow. Class A thus differs little from ulcers found elsewhere.

TYPE B.

This is a phagoedena. The striking feature of this type is rapid advance. In a matter of/

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Fig. 5

Typical phagoedenic (B) ulcer of 2 weeks duration. Note the completely hopeless condition of the edge. The brightly shining areas in the base are oedematous pieces of slough.

Fig. 6

On left, a typical phagoedenic ulcer (B or C). On right, a similar type of long duration. Spontaneous healing may reach the degree shewn, but seldom progresses further. The excessive, sclerosed, bone requires removal.

of days, such an ulcer may attain a size of three inches diameter, and may be of any shape from an even circle, or ovoid, to an irregular crater which is better seen than described. The appearance may sometimes suggest a very bad carbuncle, but gives a much greater feeling of hopelessness when seen.

There is an undermined edge, the base is covered by an indescribably foul slough, saneous, and greyish, or yellowish in colour, and the ulcer bleeds readily. The odour is one of the most repulsive conceivable, and is appreciated from afar. Separation of the slough leaves a bleeding, oozing base, devoid of reaction. The surrounding tissues are oedematous, and the surrounding skin is glazed, becomes more and more lifeless, and ultimately may slough. Necrosis of the underlying tissues keeps pace, and so the process advances. Should nature attempt resistance, granulations may appear, but the whole process strikes the observer as futile. The granulations are simply floated up by oedema, and, should any skinning have been proceeding, the new edge becomes everted. One glance suffices to convince that little good will come by leaving alone. The whole process suggests tissue death, independent of external agency, as though something were so lacking/

lacking that life cannot continue, and the cheaper tissues thus go first.

Spread proceeds along the line of least resistance, and probably along the superficial lymph path, because the ulceration does not usually affect muscle and bone as it does the skin and fascia. Should bone intervene in the line of spread, however, then it is destroyed. It is more usual to find the bone eroded and softened superficially, the carious material forming a layer which could almost be stripped by the finger-nail.

Recovery seems to be a matter of considerable luck, but it does occur in some, and as regeneration in the higher vertebrates amounts to a replacement by "cheap" tissue, the resultant fibrosis gives rise to a very insecure area. A trivial injury in situ may cause recurrence. Deformity is frequent, and a common one is a large furrow, dipping deeply into the normal contour of a limb.

Most of these phagoedenic ulcers are found on the lower extremity, and below the knee. This is the rule with any ulcer, whatever the type, but the fact has always been stressed in the case of Ulcus tropicum. The view that the lower limb is more liable to trauma is not convincing. It seems more likely to be/

be due to the erect posture of mankind, gravity becoming an obstacle under certain circumstances, which normally would be overcome by a well-nourished circulatory system. Cases occur in Uganda which go far to disprove the view of exposure to trauma, and not a few cases are literally covered with areas of phagoedena, irrespective of pressure, and giving the impression of wholesale local death.

Owing to the rapidity of spread and, consequently, the relatively short duration of this type, the patient usually has a fair idea as to mode of onset, and the usual, if spontaneous, is a watery or semi-purulent vesicle, more rarely a pustule, or "boil". As there has been ample opportunity to observe the actual mode of onset, it can be stated forthwith, that the vesicle is the rule. The cuticle is simply floated up, rather like a burn. The size usually varies from $\frac{1}{4}$" to $\frac{3}{4}$" in diameter. There may be a zone of congestion surrounding it, but this may be absent. The contents are watery, or semi-purulent, and often saneous, the cuticle transmitting a dull, reddish glow. Whatever is done to prevent advance usually fails, and an ulcer results. Although, naturally, this can be controlled, nothing seems to prevent the actual ulcer from forming.

TYPE/

Fig. 7

Left, an arresting phagoedena. Right, a similar ulcer treated with calcium and elastic pressure. Note the bright (pink) zone. This is measured, the dimensions of base being ignored.

Fig. 8

Left, a typical phagoedena. Note glazed, useless, skin round ulcer. This will probably die. Centre, early phagoedenic onychia of toes (not well seen). Right, phagoedenic onychia, left little toe and over rather large area under toe.

TYPE C.

To this group are relegated these ulcers with a history of trauma or chigger infection, which, either subsequent to admission, or by the time they are first seen, have assumed phagoedenic characters. They thus do not differ in appearance from Type B, but simply have a different origin. Fissures between the toes fall into line here with a certain degree of frequency. The phagoedenic onychia, or even the denuded foul-smelling heel, can usually be traced to the activities of Tunga penetrans, but it must be admitted that many of the others may not be due to trauma at all; the patient's word is accepted, that is all. In these onychia cases, the bone soon becomes destroyed, and it is easy to lever out the whole of a distal phalanx with the sharp spoon.

Chigger lesions frequently become phagoedenic. When it is remembered that the well-nourished, cleanly native is very punctilious with regard to the removal of chiggers so easily acquired, and is so dexterous that only the chigger itself is pierced by the needle, it may be assumed that the more fortunate of our black brethren do not unduly infect the cavity. It/

It is the debilitated native who becomes infected. Multiple chiggers in a native may not indicate uncleanliness, but often indicate the neglect of the sick man - just the type to succumb to severe infection.

TREATMENT.

It is not the purpose of this paper to enlarge on therapy, as first, this is partly surgical, secondly, it amounts to any sort of local dressing which will satisfy the usual postulates, and, thirdly, the general treatment is dietetic, antihelminthic, and so forth. For the sake of completeness the methods found to give most satisfactory results will be mentioned, although it must be stressed that this is an entirely personal matter; everyone may have a different method.

I. SCRAPING

In many cases, of all types, it is necessary to curette, as:

(a) There may be excessive sloughing

(b)/

(b) There may be excessive fibrosis, and such ulcers never do well by themselves.

It is often unnecessary to curette the smaller ulcers, of shorter duration, but all cases likely to be under special investigation and therapy should be curetted. This is necessary in order to standardise the area, because it will be shewn the chief obstacle to healing in the East African is the absence of skin reaction. Most treatment is directed towards the promotion of epithelisation.

Ulcers, being of extremely diverse shape, the standard aimed at is an even circle or oval, or if this entails too much sacrifice of healthy skin (unusual), at least a clean-cut edge. The base must be cleared of fibrous tissue. If this is impossible, then as much fibrosis as possible should be removed in order to give granulations, once formed, a chance to remain of a healthy, red colour. Necrosed bone must be removed. It is of no use attempting to preserve unhealthy, glazed skin: this should be removed as soon as possible, as it invariably comes to a bad end, if left.

It has been found that such an operation is accomplished more quickly and more thoroughly if the soft/

soft tissues are "sliced" or "pared" away with a scalpel with a to-and-fro sawing motion; necrosed bone must be removed with the spoon. Pure carbolic acid is then applied, and left for five minutes, the cauterised surface then being removed. As far as possible, the skin and base are cut to form a continuous plane, or at least to merge one into the other without unnecessary ridges.

After a time, depending on the general condition of the patient, granulation tissue forms and the surface becomes a healthy red. In some fortunate cases this is well-established in one to two weeks, but in others many weeks may elapse before this desirable stage is reached. It is obvious that, if a patient is markedly anaemic, a red base cannot be expected until the anaemia lessens. Epithelisation rarely commences before a red base is obtained, thus it is useless attempting therapeutic investigation before this ideal is established.

II. DRESSING

Magnesium sulphate solution has been found to give results which are more satisfactory than B.1.P.P., Z.1.P.P. paraffin casing, strapping, eusol, formalin/

formalin and boric, to mention some of the many preparations used. The method of strapping, and leaving for prolonged periods, simply swabbing away the foul discharge from the outer surface of the plaster, has been tried. Apart altogether from the patient's objections as to odour, success has only been achieved when the ulcer has healed all but half-an-inch across, when tight strapping over a zinc ointment dressing has definitely been of value. Unguentum "pellidol" (Bayer) is particularly useful at this stage.

Magnesium sulphate is used in strengths varying from 10% to saturated solution, depending on the situation of the ulcer. A sensitive region, such as a finger or toe, cannot be subjected to a vigorous onslaught with a saturated solution. In fact, should more than a slight burning sensation be experienced, the solution is too strong. The average patient, given a suitable dilution, does not object to the initial sensation, and generally prefers magnesium sulphate. Should the patient request another dressing this is granted, but he is excluded from further investigation, having departed from the standard treatment.

Magnesium sulphate acts probably due to its osmotic/

osmotic tension. Being hypertonic, it attracts the tissue fluid, and ensures a certain degree of hyperaemia. Leucocytes are attracted to the surface and local defence is increased. Phagocytosis may remove dead tissue not previously removed. Bacteria may be incapacitated by dehydration. Hypertonic saline does not have the same effect.

III. PRESSURE.

A considerable proportion of ulcer cases present themselves with a persistent local oedema. This may have become so indurated as to suggest a coincident filarial elephantiasis, this condition not being uncommon.

If, say, the ulcer is on the ankle and the oedematous ankle is twice its normal size, compression to a girth nearer the normal will correspondingly decrease the dimensions of the ulcer - perhaps not in a mathematical proportion, but certainly to a considerable extent. There will thus be less denuded area to cover. The pressure may be considerable without either inhibiting arterial supply or venous return, and the harder the oedema, the more tightly may the pressure be applied. The superficial/

superficial stasis allows of exudation of fluid into the superficial tissues. Pressure reduces this stasis, and diverts venous blood into deeper veins, which are unaffected by the pressure, as are the arteries. It is surprising how often a deeply congested, almost purple base, pales to a healthy red by this simple procedure.

The most economical appliance has been found to be a rubber bandage, which may be prepared at trifling cost from inner tyre-tubes. For a soft oedema a bicycle tube suffices; for an organised, hard oedema, a motor cycle or motor-car inner tube is used. Considerable pressure can be exerted without causing numbness and swelling distally. The advantages over elastoplast and adhesive plaster are several. Cost being one, and facility of daily dressing being another.

IV. SKIN-GRAFTING

This is employed when it is desired to evade excessive contracture at a later date, and also to save time, once it is assumed that special treatment has had the desired effect. The method is simple, but is only used when the base is a very healthy/

healthy red colour. Pieces of skin are shaved from the thigh and placed on the base. The pieces should not have adipose tissue on the under-surface, and should not be larger than the size of a finger-nail. Each graft is capable of a spread, all round, equal (roughly) to its own diameter. The area is next covered with a single layer of gauze, and a normal saline dressing is placed on top. The grafts are kept moist with saline and all dressings are done over the layer of gauze, which remains in situ until the area has healed.

V. MEDICINAL

Should the base appear weak and pale, an increase of tissue metabolism seems to bring it up to expectation in many cases. Thyroid extract usually causes a marked improvement, but requires time. Less expensive and of quicker action is protein shock, which is usually employed now, T.A.B. vaccine being used. The few hours rigor and pyrexia is remarkably beneficial, and many an incipient fibrosis is stayed. This treatment is repeated every third day if required.

So far, treatment has been directed to mesodermal tissues. It so happens that not a few cases show satisfactory mesodermal behaviour, as evidenced/

as evidenced by a healthy base. This does not mean that the ulcer will heal. In the usual class of patient who suffers from ulceration, the skin may produce a faint new pellicle at the edge, but weeks later there is no further progress. Parathyroid deficiency leads to trophic disturbances (BANDLER)[1], especially as regards ectodermal structures; this is too well-established clinically to be open to question and it is well-known that trophic changes such as loss of dental enamel, brittleness of nails, cataract, etc. are often found in latent tetany. As the difficulty in healing of an ulcer was found to be due to lack of ectodermal reaction, parathyroid extract was given orally to some refractory cases during 1929, and the marked improvement which resulted furnished a clinical proof that such a deficiency existed in the ulcer class of Uganda. The extract was given orally in spite of the evidence (so called) that the active principle is destroyed in the alimentary tract, and the results definitely indicated absorption. (Sprue, during the period when parathyroid deficiency was believed causal, was not treated by injection and many clinicians reported success/

success with oral parathyroid extract. Parathyroid extract was given orally for many conditions before parathormone was isolated and, moreover, with success.)

The extract was given with gr. v of calcium lactate, thrice daily on an empty stomach, to cases which were particularly refractory. As it was hardly fair to any treatment to try it on ulcers with stony fibrosis, only those cases with strict ectodermal insufficiency were treated, i.e. those with a good base but no skin reaction. No skinning could be hoped for in an ulcer with a pale, waxy base any more than skin grafts could be expected to "take". As only a limited supply of the extract was available (actually Tab. Thyrocalx Mulford. gr. 1/10 + calcium lactate gr. v) only twenty cases were treated. The results were almost spectacular, and in remarkably few days' time (mostly little over a week, and so similar to the time of absorption of thyroid) epithelisation was observed in every case. Some skins could almost be observed to advance daily. The supply only lasted a matter of ten days, but within that time several smaller ulcers had practically healed, and others progressed for some time, gradually slowing down, but not to the original level. All cases/

cases ultimately healed, however, and in a remarkably short time. The results were thus encouraging, as several of these cases with very extensive ulceration of the legs had been in hospital for months, being almost given up as hopeless.

Since then, parathyroid and calcium have always been given to refractory cases and the original findings have often been borne out. Some failures will always occur, as they do in any condition, but in the case of ulcer, these have been found to be due to fibrosis. There have been failures, for instance, which cleared up after rescraping, others after T.A.B. vaccine. It must be repeated, therefore, that the first aim is to remove the septic process, and ensure a good base. If this is done, and the patient has any ectodermal reaction left, then epithelisation will occur. As there is often no such reaction, parathyroid is necessary in these cases, and, if given when conditions are suitable, a good result may be expected.

INTRAVENOUS CALCIUM

LOEWENTHAL[2], in 1931, working independently at Mbale in Eastern Province, after a survey of the dietary/

dietary of the local population, considered that possibly a calcium deficiency existed. He instituted calcium therapy, giving gr. xv of calcium chloride in 10 ccs. distilled water, by the intravenous route. His results were encouraging, and a point he stressed is the fact that, without resort to scraping, the stench of the ulcer disappears in a few days. In his own words "a ward which used to be insufferable during the night round, becomes odourless."

INTRAVENOUS CALCIUM and ORAL PARATHYROID.

This is superior:

(a) to intravenous calcium alone

and (b) to parathyroid and oral calcium,

consequently intravenous calcium chloride is first tried, and if the results are not sufficiently encouraging, parathyroid is added and frequently the ulcer is spurred on to a better status.

It thus appears possible that there is a parathyroid deficiency, because oral parathyroid often seems to improve ulcers. There also seems to/

to be some disturbance of calcium metabolism, as a deficiency appears to exist. Extensive analysis of foods, and possibly sera, may clear this up, although in connection with the estimation of the serum calcium, the various states which exist within the term "total calcium" may be many, and an estimation of serum calcium may mean much, or very little.

ETIOLOGY

The African is not the redoubtable warrior often portrayed in fiction. It is, unfortunately, the case that many an East African native is a sorry specimen of humanity, miserable, and without either stamina or spirit. In a high percentage of the native population there are numerous laboratory "positives" and the subject varies from a veritable museum to simply "malarial parasites present." It is far from unusual to find a patient, whatever his illness, with taenia, hookworm, ascaris and T. dispar ova in his stool; quartan and/or subtertian parasites in his blood, plus a strongly positive Kahn reaction, and possibly scabies and chiggers.

The only redeeming feature of such cases is that they have a taenia infection, as this clearly indicates that a certain amount of meat has been eaten.

Allowing for a certain amount of immunity, or better, perhaps, tolerance, to these infections, it is surprising that the poorer native survives at all. With an average white blood count of 4000-6000 at the outside, and polymorphs and lymphocytes in inverse ratio, the native who survives pneumonia and such/

such acute infections, deserves a credit mark. With such disadvantages, it is surprising for a native to recover from anything, and it is hardly to be wondered at that senile decay sets in earlier than in the European.

The above indicates that there is a marked predisposing factor to infection. The native is at a disadvantage; possibly he is lucky even so, as not so long ago the infant mortality in Uganda was extremely high.

BACTERIOLOGY.

In 1929[3] smears were taken from 26 cases of ulcer. Of these, 17 shewed a fusiform bacillus, associated with a spironema, these organisms resembling morphologically those found in Vincent's angina, and presumably the same as found by SMITH[4], and which were named Treponema schaudinni. The smears were taken from the base of the ulcer, and also from under the advancing edge, by capillary tube. A dark-ground examination was also done in addition to gram-stained films. Of these ulcers, all 17 were phagoedenic. One shewed B. fusiformis alone. In all cases the organisms were present practically to the exclusion of all others. In one of the 17 cases, the fusiform organisms were also present in a femoral gland.

9 cases shewed other organisms only, which were chiefly staphylococci, diplo-streptococci, and gram negative diplococci resembling the gonococcus. One case shewed also a diptheroid. Neither fusiform bacilla nor spironemata were present: these cases were not phagoedenic.

In 1930, further examinations were undertaken, vide infra.

The/

The question naturally arose as to whether or not the presence of Bacillus fusiformis and spironema in phagoedenic ulcers was simply a coincidence, bearing in mind that the consensus of opinion, in spite of the work of TUNNICLIFFE[5], is still in favour of a saprophytic symbiosis. Against coincidence was the fact that the organisms were only present in the phagoedenic type and not in the others, and that in one case they were present in a lymph gland.

During 1931, in Edinburgh, it was possible to make a special investigation of the bacillus, working with Vincent's organisms obtained from cases of Vincent's angina, fusiform bacilli and spironemata obtained from genital sores, and Tr. refringens obtained from gums. Repeated attempts to isolate B. fusiformis in pure culture failed. The methods employed were the following:-

(a) Smears on ascites agar (1:3) slopes, after Tunnicliffe. Stroke inoculation on to plates of the same composition.

(b) Loeffler's blood serum.

(c)/

(c) Smith's modified Wenyon medium i.e. N/1 saline 320 ccs. and 2% nutrient agar, 40 grammes, are mixed and autoclaved for 10 mins. at 120° C. After cooling to 37° C., 15 ccs. of human blood are added, and the whole is agitated and subsequently distributed in tubes by sterile syphon. The tubes are incubated for 48 hours at 37° C. before use.

(d) Blood agar plates. These were incubated in the anaerobic jar.

(e) Bullock heart medium, sealed by liquid paraffin.

In the case of B. fusiformis alone, there was never any difficulty in obtaining a growth, but it was impossible to obtain it in pure culture. The rule was, after 24 hours at 37° C., a growth of other organisms. These were Gram positive cocci, either streptococci, staphylococci, or diplococci; Gram negative cocci; Gram negative bacilli, unlike B. fusiformis; Gram positive bacilli. After a further 24 hours incubation, usually B. fusiformis appeared, and multiplied actively. In numerous strains, repeated subculture failed to obtain a pure growth. No growth of the spironema was ever obtained, either anaerobically or aerobically. As it was specially desired to obtain a pure culture of the bacillus, a further attempt was made to isolate/

isolate it. Plates, after incubation for 24 hours, were heated to various degrees in the hope that the other organisms might die earlier than B. fusiformis. This was unsuccessful. Subsequently, the other organisms were plated, a profuse growth was obtained, and this was heated at 65° C. for periods varying from 5 to 15 minutes. The heated growth was then incorporated in fresh plates of ascites agar and blood agar, and throat smears were plated-out on these. On five occasions isolated colonies of B. fusiformis were obtained and were picked out from the numerous colonies of other organisms. The colonies were small, semi-translucent, round or oval. The edges tended to throw out fine filamentous prolongations. The bacillus was extremely filamentous, elongated and tended to lose its typical "barred" appearance. It was non-motile. Reproduction was apparently by transverse fission, pieces simply breaking off when the filaments reached a considerable length.

These colonies were transferred to further plates of the same medium, but were incapable of carrying on an independent existence. All five strains behaved similarly; there was no growth after many days of aerobic and anaerobic incubation.

Inoculation/

Inoculation of mice and rats intradermally with suspensions of the colonies, and also with the mixed growth, produced negative results. Intraperitoneal inoculation of mice with mixed growth failed to obtain multiplication of B. fusiformis.

Culture, in a pure state, of Bacillus fusiformis thus failed, although an encouraging stage was reached, namely, the obtaining of pure colonies. The failure to perpetuate these independently may be explained by their probable inability to exist outside the "metabolic" zone of other organisms. Animal inoculation was negative: this is consistent with the findings of others.

Examinations of ulcers during 1930, 1932, 1933 and 1934, show the following results:-

1930: Of 110 cases, 56 shewed B. fusiformis, with or without the associated spironema. 54 shewed other organisms, but no B. fusiformis. Analysis of the 56 fusiformis cases shewed that 49 were frankly phagoedenic, 5 were doubtfully phagoedenic, whilst two were not phagoedenic and presented the characters of class A. The mode of onset in 27 cases was unknown: 19 were the result of trauma; 10 had a spontaneous origin. As regards the 19 cases due to trauma/

trauma, 4 were the result of chiggers, 1 was stated to have followed the bite of an insect, 1 was due to a burn, and 13 were due to frank trauma, e.g. a cut, a scratch, a thorn. As regards the 10 "spontaneous" cases, in 3 the mode of onset was a vesicle (or "bleb", the native word being 'kitulituli'), 1 commenced as a boil, 1 commenced as a fissured plantar keratosis, and 5 were uncertain.

These results are set out in TABLE 1. It will be observed that few cases during this year had their origin as a vesicle, whilst a fair proportion were due to trauma, i.e. class C, though still presenting typical clinical appearances. It is noticeable, however, that nearly 50% of the cases had an unknown origin, and conceivably many might have arisen spontaneously, possibly as blebs. A large number were BanyaRwanda, a tribe with a low degree of intelligence.

TABLE/

TABLE 1.

ANALYSIS of 110 CASES of ULCER examined BACTERIOLOGICALLY during 1930

B. fusiformis and/or Sp. schaudinni present — TOTAL 56				B. fusiformis and/or Sp. schaudinni absent. — TOTAL 54			
Clinical Type	No.	Antecedent Condition	No.	Clinical Type	No.	Antecedent Condition	No.
Phagodenic	49	Unknown	27	Phagoedanic	3	Unknown	26
Doubtful	5	Injury	19	Doubtful	2	Injury	16
		Vesicle	3				
Non-phagoedenic	2	Boil	1	Non-phagoedenic	49	Spontaneous:	
		Fissure	1			Fissure 1	
						Sinus 1	
		Uncertain	5			Gumma 3	12
						Vesicle 3	
						Boil 2	
						Scabies 1	
						Uncertain 1	
TOTAL	56		56		54		54

Of the 54 cases showing other organisms, but no B. fusiformis, 49 were not phagoedenic and were definitely class A ulcers in appearance: 2 were frankly phagoedenic and may have shewn B. fusiformis previously, though not at the time of examination: 2 were doubtful, i.e. they looked like class A ulcers of some duration, which were assuming sloughing characters. Of the total 54 cases, 16 were the result of frank trauma, 26 were unknown, 12 were spontaneous, or rather the patients thought that they came by themselves and, of these, 1 was stated to have commenced as a fissure in a patch of plantar keratosis; 3 were clinically "gummata gone wrong"; 1 was an ulcerated sinus; 2 were "boils" (i.e. not necessarily staphylococcal boils, but boil-like); 1 was due to infected scabies; 1 was uncertain; 3 commenced as vesicles, suggestive of herpes, but certainly not the type of bleb observed in the case of class B, and the ulcers themselves were certainly not phagoedenic.

The organisms, when present (absent entirely in 8 cases), were found to be Gram positive cocci, staphylococci, Gram positive bacilli (not diptheroids), Gram negative bacilli, and Gram negative cocci and diplococci morphologically suggestive/

suggestive of the gonococcus.

Allowing for a certain amount of overlapping, it is evident that ulcers shewing B. fusiformis with or without Spironema schaudinni, were phagoedenic to a great extent. If the doubtful cases, even although they may have been early cases, are considered as non-phagoedenic, the proportion of true phagoedenic ulceration in this group is still 87% approximately. The ulcers shewing other organisms were chiefly class A. Of 54, only 3 were phagoedenic (1 due to chigger, 2 unknown) and, allowing for the other 2 doubtful cases, the non-phagoedenic nature of the process amounted to 90% approximately.

1932: Of the total male ulcers treated, 128 were examined for bacteria. Of these, 80 shewed B. fusiformis with or without spironema, and either alone or associated with other organisms; 48 shewed other organisms only, but not B. fusiformis.

As regards the 80 fusiformis cases, 41 shewed B. fusiformis only, no other organisms being seen; 4 shewed B. fusiformis alone; 35 shewed B. fusiformis and other organisms. The other organisms were similar to those noticed during 1930, but/

but in 4 cases diphtheroids were present.

73 of the above cases were phagoedenic, 5 were not phagoedenic at the time of examination, and 2 could not be classified, though of these 1 later shewed malignant changes. With regard to the 7 non-phagoedenic or unclassifiable cases, 6 were due to trauma and 1 was unknown, but presumed spontaneous.

The phagoedenic cases had their origin as follows:-

Spontaneous:-

Vesicles	27
Boils	2
Pustules	6
Uncertain	2,

making a total of 37.

Injuries:-

Chiggers	9
Insect Bites	2
Frank Trauma	25

making a total of 36.

48 cases, not shewing the fusiform bacillus, were as follows:-

20 shewed no flora at all in direct smears, 4 shewed diptheroids; 1, a yaw, shewed Tr. pertenue; the others shewed the usual mixture as described above. 8 of this group were phagoedenic but may have been dressed prior to admission. They are simply included in this group, due to the bacteriological classification, as they did not shew B. fusiformis, and thus, strictly, may belong to the other group. 7 of these started with vesicle formation, and 1 was uncertain. One case could not be classified; it was said to have commenced as a vesicle ("bleb").

The remaining 39 cases were not phagoedenic and were typical examples of class A. 19 were spontaneous:-

"boils"	5
pustule	1
vesicles	6
yaws	2
gummata	1
uncertain	4

20 were the result of injury:-

2 bed-sores, arising during previous illness, 1 insect bite, and 17 were due to frank trauma. These figures are recorded in TABLE 2.

TABLE/

TABLE 2

ANALYSIS of 128 CASES of ULCER examined BACTERIOLOGICALLY during 1932

B. fusiformis and/or Sp. schaudinni present TOTAL 80				B. fusiformis and/or Sp. schaudinni absent TOTAL 48			
Clinical Type	No.	Antecedent Condition	No.	Clinical Type	No.	Antecedent Condition	No
Phagoedenic	73	Injury, including insects and chiggers	42	Phagoedenic	8**	Injury, including insects	20
Doubtful	2*			Doubtful	1		
Non-phagoedenic	5	Spontaneous: Boils 2, Uncertain 3, Pustules 6, Vesicles 27	38	Non phagoedenic	39	Spontaneous: Boils 5, Uncertain 4, Pustules 1, Yaws 2, Gummata 1, Vesicles 6	19
						Plus 8** Phagoedenic and 1 doubtful Vesicles 7, Uncertain 2	9
TOTAL	80		80		48		48

* Malignant.

** May have shewn B. fusiformis before dressing.

It is apparent that the ulcers shewing B. fusiformis, with or without spironema, and/or other organisms, are largely phagoedenic, actually 66% approximately. Allowing for 8 cases in the other group, which may have shewn B. fusiformis previously, the ulcers in the "other organisms" group are mostly class A, i.e. 81% approximately.

Of the phagoedenic ulcers, from both groups, quite a number commence as "blebs" (41% approximately.)

1933: During this year 112 cases were examined for micro-organisms. 59 shewed B. fusiformis, with or without spironema and other organisms. 53 shewed other organisms, but not B. fusiformis. Analysis of the 59 cases in the fusiform group shewed that 53 were phagoedenic, 5 were not phagoedenic, although shewing the characteristic flora, and 1 was not classified.

The mode of onset in the 5 cases was trauma. Of the 53 phagoedenic ulcers, 19 were spontaneous:-

Papules	2
Yaws	1
Pustule	1
Vesicle	11
Unknown	4
Following injury	34
Chiggers/	

Chiggers	6
Snake bite	1
Frank trauma	27.

Analysis of the 53 cases not shewing B. fusiformis shows that 13 were phagoedenic, but these are included in this group as no fusiform bacilli were present at the time of examination. The origin of these was as follows:-

Vesicles	4
Chigger	1
Pustules	3
Trauma	5

40 were not phagoedenic, and conformed to type A. Of these, 19 were spontaneous:-

Gumma	1
Yaws	4
Uncertain	5
"Boils"	2
Pustules	3
Vesicles	2
Abscess	1
Scabies	1
Result of Injury	21
Frank trauma	20
Chigger	1

These figures are set out in TABLE 3.

TABLE/

TABLE 3

ANALYSIS of 112 CASES of ULCER examined BACTERIOLOGICALLY during 1933

B. fusiformis and/or Sp. schaudinni present TOTAL 59				B. fusiformis and/or Sp. schaudinni absent TOTAL 53			
Clinical Type	No.	Antecedent Condition	No.	Clinical Type	No.	Antecedent Condition	No.
Phagoedenic	53	Injury, including insects and chiggers	39	Phagoedenic	13*	Injury, including insects and chiggers	27
Doubtful	1			Doubtful	0		
		Spontaneous:				Spontaneous:	
Non-phagoedenic	5	Papules 2 Pustule 1 Yaws 1 Unknown 5 Vesicle 11	20	Non-phagoedenic	40	Gumma 1 Yaws 4 Boils 2 Pustule 6 Abscess 1 Vesicle 6 Scabies 1	21
						Uncertain	5
TOTAL	59		59		53		53

* May have shewn B. fusiformis at earlier date.

Again, it may be seen that a large proportion of the cases with B. fusiformis present were phagoedenic (89.8%) and a fair proportion of these appear to have commenced spontaneously. Of the other group, only about 24% were phagoedenic and some of these may have shewn B. fusiformis had smears been taken earlier, before dressing.

1934: 73 male cases of ulcer were examined before it was necessary to close investigations.

33 of these shewed B. fusiformis with or without Sp. schaudinni. 15 were due to frank trauma, 6 resulted from chiggers, 9 commenced as vesicles, 1 was presumably a yaw, and 2 were unknown. 11 of the 15 traumatic ulcers were phagoedenic; 8 of the 9 ulcers arising as vesicles, were phagoedenic. All the chigger onychia cases were phagoedenic, following what seems to be almost a general rule. The "yaw" and the remaining 2 of uncertain origin were all phagoedenic.

Of the 40 cases not shewing the fusiform organism, 14 were the result of frank trauma, 3 were due to chiggers, 1 commenced in the puncture of a guinea-worm, 10 arose as a vesicle, 1 commenced as a pustule, 1 from an abscess, 1 from a papule, 1 was the result of oedema, 1 was the result of a burn, and 7 were unknown. Cf. TABLE 4.

TABLE/

TABLE 4

ANALYSIS of 73 CASES of ULCER examined BACTERIOLOGICALLY during 1934

B. fusiformis and/or Sp. schaudinni present TOTAL 33				B. fusiformis and/or Sp. schaudinni absent TOTAL 40			
Clinical Type	No.	Antecedent Condition	No.	Clinical Type	No.	Antecedent Condition	No.
Phagoedenic	28	*Injury, including chiggers and insects	21	Phagoedenic	15	§Injury, including chiggers & insects, worm etc.	19
Non-phagoedenic	5	Spontaneous:		Non-phagoedenic	25	Spontaneous:	
		**Vesicles	9			§§Vesicles	10
		Yaws	1			Papule	1
			10			Pustule	1
		Uncertain	2			Abscess	1
						Oedema	1
						Uncertain	7
TOTAL	33		33		40		40

*17 Phagoedenic
** 8 Phagoedenic

§Only 5 Phagoedenic
§§ 9 Phagoedenic

Once again all chigger ulcers were phagoedenic; all, bar one, of the ulcers commencing as blebs were phagoedenic. All, bar one, of the 7 "unknown" ulcers were indolent, non-phagoedenic ulcers. Only 2 of the injuries were phagoedenic. The others were typical of class A. The ulcers arising as vesicles are only included in this group because no Bacillus fusiformis was found. They may thus belong to the other group.

Most of the work has been confined to male cases. This is inevitable in hospital practice, as the hospital is divided into special departments, and all female cases, whatever the condition, have until recently been under the care of one practitioner. 42 female cases, of whom records were available, shewed that much the same types of ulcer are found in the female.

During 1932 records of 28 cases were examined. No bacteriological investigation had been carried out in 6 cases. Of the remaining 22, 9 shewed B. fusiformis and spironema; 13 shewed no organisms, or other organisms, chiefly staphylococci, Gram positive and Gram negative bacilli, and Gram negative cocci.

During 1933, 14 cases were actually examined by the writer. 3 were positive for B. fusiformis. There were no organisms in 5 cases, and other organisms in 6.

TABLE/

TABLE 5.

ANALYSIS of all MALE CASES OBSERVED DURING 1930, 1932, 1933, 1934.

TOTAL CASES 423.

Clinical Type	B. fusiformis and/ or Sp. schaudinni present TOTAL: 228 = 53.90%		B. fusiformis and/or Sp. schaudinni absent. TOTAL: 195 = 46.10%	
	Number	Percentage	Number	Percentage
Phagoedenic	203	89.03	39	20.00
Doubtful	8	3.51	3	1.54
Non-phagoedenic	17	7.46	153	78.46
TOTAL	228	100.00	195	100.00

TABLE 5 shews the total cases observed from 1930 to 1934, and a glance will suffice to appreciate that the figures bring out strongly the correlation of B. fusiformis and spironema with the phagoedenic type. In point of fact, the number of phagoedenic cases might even be more considerable were the classification other than strictly bacteriological, as some of the 20% of phagoedenic ulcers in the fusiform negative group could be displaced. One look at such ulcers often convinces the observer that fusiform organisms must have been present even though the smears shew none.

From a clinical standpoint it is shewn that ulcers are divided into two categories, viz. phagoedenic and non-phagoedenic. A certain amount of overlapping occurs, as clinically it is often very difficult to conclude what class of ulcer is under observation. Perhaps the ulcer has been phagoedenic, but has become quiescent and A-like; or perhaps an injury looks rather angry and almost B-like. In practice, however, few of these cases escape proper classification; the proportion of doubtful cases in TABLE 5 is not high.

In the series of 423 males examined bacteriologically, 53.9% were found with B. fusiformis and/or Sp. schaudini in the base of the ulcer or ulcers/

ulcers and under the edge. Of these, no less than 89.03% were phagoedenic, i.e. either class B or class C. 3.51% were doubtful, and 7.46% were not phagoedenic, although positive as regards the fusiform organisms. The presence of these organisms in non-phagoedenic ulcers has on many occasions been found to herald a change in character, such ulcers becoming phagoedenic; the appearance of the organisms should indicate the need of more frequent dressings and an increase in the concentration of the local application.

46.10% of the series were negative as regards B. fusiformis, shewing other organisms as specified above. Of these, 78.46% were not phagoedenic, 1.54 were doubtful, and 20% were phagoedenic.

DISCUSSION.

A large proportion (89.03%) of ulcers shewing B. fusiformis, with or without spironema, are phagoedenic. This is well-known and is described in text-books. Doubt is always cast on the pathogenicity of such organisms, and they still seem to be considered as saprophytic. Certain points require investigation however:-

(a) An ulcer, resulting from an injury, has the appearance of an ordinary class A ulcer such as may be seen anywhere. This ulcer suddenly becomes angry, the edge breaks down, a slough forms and often in a remarkably short time a typical class B results. This change may occur before the case is seen, but may also be observed in hospital, and in spite of dressings. Associated with this change B. fusiformis and spironema are found. This may be more than coincidence. The possibilities are:-

(1) that some change for the worse occurs in the ulcer, and more necrotic material is formed on which these organisms can live;

(2) the organisms are introduced, and themselves cause the change.

(b)/

(b) Less doubt is cast on the membranous pharyngitis with which Vincent's organisms are associated, and also such conditions as ulcerative gingivitis, in which condition B. fusiformis may be found. Both these conditions are common in Uganda, and respond to arsenic in the form of neotreparsan, sulpharsenal, etc. What is acceptable in such cases may also be acceptable in similar cutaneous lesions, and this has received the attention of other workers, the findings of whom are summarised in this section. One difference is rather striking, namely, that Vincent's angina and kindred conditions respond to arsenical medication, either local or general, and it is admitted that many organisms, notably treponemata, e.g. pallidum and pertenue, and spironemata, such as Dutton's and Vincent's, are very susceptible to this metal. In the case of ulcers in the writer's charge, this striking benefit was not obtained.

This may indicate:

(1) that the fusiform organisms and spironemata are not causal, being, in fact, really saprophytic;

(2) that the Uganda organisms belong to a different strain, resistant to arsenic, and not the same Uganda strain associated with stomatitis and pharyngitis.

Because/

Because some of these organisms are susceptible to arsenic, it does not follow that all are. Certainly intravenous salvarsan substitutes have not had this effect, and the local application of solutions of the drug have not proved more efficacious than ordinary dressings.

(c) If B. fusiformis is to be considered pathogenic, it might be expected that these organisms should be present in the vesicles which so often precede the spontaneous type of phagoedena. Numerous vesicles have been examined during the course of this investigation, as recurrences while in hospital are far from uncommon, as are ulcer cases admitted shewing vesicles on other regions of the body.

These vesicles have always been negative, except on three or four occasions when scanty Gram positive cocci have been found. As a rule, the fluid contents of such "blebs" show nothing but a few leucocytes. A certain amount of speculation is permissible in a discussion, and so consideration of the "infective granule", as a stage in the life-history of the organism, would not come amiss. In the case of Sp. duttoni, an organism very common in Uganda, "chromatin" granules are found in the excretory tubules/

tubules of infective ticks; these are supposed to carry-over to the next generation.

This is departing from the particular spironema under discussion which, of course, is associated with a fusiform bacillus, but TUNNICLIFFE[6] in 1923 described bodies inside the parent "filaments" of Bacillus fusiformis. Under certain conditions these appeared to fall off and develop into motile spirilla. The possibility of such a stage being present in the vesicles of ulcer cases is worth some consideration at any rate. Such granules would later develop into the typical organism, but as no such bodies have been cultivated, the matter remains one of speculation.

A complete life-cycle was described by Tunnicliffe, and the bacillus was claimed to form the spironema. No such phenomenon was noted by the writer. Further work is necessary to clear up the vexed question of the relationship, if any, of the bacillus and the spironema. Tunnicliffe's work indicates metamorphosis, whilst the idea of symbiosis suggests that the organisms are distinct, but always come together at the feeding place by some strange means. The difficulty encountered in working with these organisms is considerable, as the ideal of obtaining a pure growth/

growth to begin with is seldom realised. (The writer's failure to isolate the organisms in pure culture may simply add one more failure to a long list.)

(d) Animal inoculation has always proved unsuccessful. This is not surprising as animal results are not by any means always applicable to man, as has often been realised. Man is not so invariably susceptible to, say, the pneumococcus as is the mouse. Individual variations in susceptibility may account for failure in human inoculation experiments which would give positive results in laboratory animals. On the other hand, negative results in animals may be found in the case of organisms to which man is notably susceptible.

In the case of ulcer, one man may behave quite differently from another, may heal more slowly, may fibrose more quickly, and so forth. It is thus unsatisfactory as well as difficult to control experiments on ulcer cases by the method usually employed in the case of animals, besides which ample opportunity has always existed for seeing the failure to heal of ulcer cases if untreated except locally. The method adopted by the writer was to make each man his/

his own control, a rather laborious method but one which ruled out variation. The ideal of human inoculation is seldom realised, as African volunteers are few. The obtaining of, say, samples by pretext is to be deprecated, but if the case is honestly put to the native and he realises that good may come from his generosity, then he invariably refuses to co-operate. Great difficulty was experienced in obtaining blood for calcium investigation, for instance, so it may be realised that volunteers for inoculation of septic material are seldom forthcoming. Nine were found during 1932 (at a price) and all were inoculated intradermally with a fresh saline suspension of B. fusiformis and Sp. schaudinni obtained from an ulcer shewing these in the absence of other organisms. The inoculum was obtained by expressing the serous exudate from the edge by means of a tourniquet. The inoculations were given intradermally to reproduce vesicle formation. As a control, a suspension of B. alkaligines was inoculated into the skin of the other leg. No ulcers resulted in any of the 9 cases. Smith in Lagos (1930) had more success. 5 volunteers were inoculated by him with impure cultures of spironema. All developed ulcers, 3 of which commenced as vesicles, 2 as boils. Smith concluded that spironemata in/

in mixed culture can proliferate in the skin and produce a lesion like tropical ulcer. Incidentally, he found no evidence of mutation in culture, which indicates that he did not confirm Tunnicliffe's findings.

The positive results obtained by Smith are thus very suggestive.

(e) B. fusiformis is a strict anaerobe: Smith's work suggests that the spironema may be cultivated aerobically. Whatever the behaviour of the spironema, it is obvious that the bacillus grows well in close proximity to air, as may be seen in phagoedenic ulcers and in Vincent's angina, in genital lesions, and in normal smegma. Under the circumstances catalase formation must be adequate in necrotic tissues or there must be other reducing mechanism provided by necrotic tissues to render conditions on the surface of the slough favourable to the growth of an anaerobe.

(f) In the case of the ulcer in which no such organisms were found, allowing for these which were actually phagoedenic but negative for B. fusiformis, the characters are entirely different, and the ulcers often present similar appearances to those found in any/

any latitude. As the difficulty with these, as with any type, is the prevention of fibrosis and the promotion of epithelisation, these will be discussed in a different section. The bacteriology of ulcers of class A is more or less similar to that of ulcers found elsewhere.

(g) During the years 1930, 1932, 1933, 1934, the entire absence from ulcers of C.diphtheriae is worthy of note in view of the prevalence of veldt sore in other parts of Africa. No cases have come to notice during these years, and the presumption is that veldt sore is uncommon. Only one case of diphtheria has been seen by the writer in Uganda. This was fatal, cultures were typical, as were guinea-pig experiments. No further cases occurred.

Inoculation of animals with strains of B. fusiformis and spironema have, in other hands, produced results however. J. BRAMS and I. PILOT[7] reported that inoculation of smegma, containing these organisms, into the pleura of rabbits, caused putrid lesions similar to those observed after injection of purulent secretion from cases of specific balanitis. The organisms were recovered from the lesions, along with associated organisms. They concluded that, although/

although the organisms are normally saprophytic, balanitis may result from B. fusiformis and spironema if the resistance is lowered. (It is notable that the resistance of the African is lowered.) W. B. ADAMS[8] described epidemic ulceration in Syria. In 1916 this was seen mostly on the legs of patients suffering from starvation oedema. There were less cases in 1917 of the phagoedenic type. In 1918 these were abundant, and in 1919 were a scourge among the poor. They were less in 1920, few in 1921, and occasional only in 1922. He described the initial lesion as being a papule. The causal organism was thought to be the streptococcus, but B. fusiformis and spironema were present. The condition was stated to be commoner in the poor. The possibility here, again, is that B. fusiformis and spironema may be causal.

I. PILOT and A.E. KANTER[9] suggested that the occurrence of these organisms with pyogenic bacteria in certain genital lesions would indicate that these organisms may be primary and secondary infecting agents causing ulceration and gangrenous processes. The occurrence could be due to diminished resistance.

The same workers[10] concluded, in 1924, that B. fusiformis and spironema are important infective agents/

agents in various lesions, including erosive and gangrenous vulvitis, although these organisms are often present in the smegma of normal women. The presence of these organisms normally would indicate that many ulcerative processes about the genitalia are due to autogenous infection and not necessarily due to bacteria from other sources.

I. PILOT and K.A. MEYER[11] described ulceration of the fingers resulting from trauma from teeth. The ulcers were very putrid and destructive, but differed from the cases under consideration in their response to arsenic. In all their cases, infection was complicated by the presence of certain pyogenic bacteria along with the fusiform organisms.

Enough has been said to indicate that B. fusiformis may take on a more active rôle than that of a saprophyte. It may be the initial cause, though it has not been found in the initial blebs. These blebs may be distinct from an external infection, and be a spontaneous breakdown of devitalised tissue resulting from dietary or endocrine deficiency. (WALTER[12] described impetigo herpetiformis as being due to endocrine disturbance, and often combined with osteomalacea.)

Subsequently, B. fusiformis and spironema appear/

appear, possibly as saprophytes, at the site of breakdown, and become parasitic and destructive. Other organisms may find their way paved for them. Against this is the fact that:

(1) in numerous ulcers of the phagoedenic (B) class, smears shew few other organisms, if any;

(2) ulcers, previously of the usual type (A) become phagoedenic (C) with the appearance of B. fusiformis often in advance of the clinical change of character of the ulcer.

It is suggested that B. fusiformis and spironema may be the cause of phagoedenic ulcer, as a definite type, because in many other cases just as devitalised, ulcers of class A only are found, and B. fusiformis is absent. The actual proof will be difficult, as a pure culture of the organism is essential for inoculation.

Up to the time of publication of his report, Smith had not succeeded in isolating the spironema in pure culture. He favoured the spironema as the causal agent, and it was in the sites of inoculation of the spironema culture that the ulcers developed. The fusiform bacillus was used as part of the control inoculum.

SEX INCIDENCE.

During the years 1928, 1929, 1930, 1931, 1932, 1933 when ulcers were investigated, the numbers of cases admitted to Mulago annually kept within certain limits, i.e. between 3500 and 4000 males and between 1200 and 1900 females.

As regards the females, it is obvious that certain conditions peculiar to the female must be subtracted in order to make a fair comparison. For instance, it is not much use including pregnancy, labour, puerperal conditions and affections of infants in the female figures, because all the male admissions are for general conditions and by subtracting the above, the female general conditions may be arrived at, but not very accurately however. The reason for this is that gynecological conditions, such as uterine displacements, are left in to counterbalance such male conditions as inguinal hernia. But usually female gynecological conditions can be seen to exceed these. Whatever the nett female figures may be, it is certain that general conditions are probably less, actually, than is possible to put on paper. Proper comparison is thus difficult, but as careful a calculation as possible shews that the percentage of ulcers/

ulcers among the total male admissions was 4.327 as compared with 2.069% for the female admissions during 1928, i.e. the males were approximately twice as many. In 1929 the male ulcers were 4.833% as compared with 3.429% female cases. In 1930 the male ulcers were 5.439%, the females being 3.471%. In 1931 the male figures were 7.638%, the female being 7.942%. In 1932 the males were 4.497%, females being 4.074%, and in 1933 the figures were 3.973% male and 2.479% female. In TABLE 6 the female figures are nett, infancy conditions etc. being deducted, in fairness to the males.

TABLE/

TABLE 6

MALE ADMISSIONS and NETT FEMALE ADMISSIONS for the YEARS 1928, 1929, 1930, 1931, 1932, 1933.

MALES			FEMALES	
Year	Total Admissions	% Ulcers	% Ulcers	Total Nett Admissions
1928	3536	4.327	2.069	1063
1929	3911	4.833	3.429	1225
1930	3806	5.439	3.471	1354
1931	3993	7.638	7.942	1234
1932	3958	4.497	4.074	1301
1933	3549	3.973	2.479	1452

DISCUSSION.

As regards Mulago, there is always an excess of male admissions over female, even inclusive of obstetrical cases. This could be accounted for in various ways: broadly speaking, the females in Uganda seem to be the inferior sex: also, they make much less fuss of their ailments than the males; they may even have less time for introspection than the males, because they do all the spade work of the household, including the cultivation of cotton, of food, the preparation of food and so forth. Further, the males are the tax payers, and although Poll Tax examinations are recorded separately, at the same time, males may appear with various complaints with a view to obtaining exemption. The usual view that males are more liable to trauma cannot hold in Tropical Africa, as often a trauma is a scratch from a reed, or something equally trivial, and females are just as liable. Also, as the female is the beast of burden, she is more likely to sustain cuts from hoes, axes, etc. and also injuries from an irate husband; corporal punishment is still meted out to wives who do not come up to the standards expected by the husbands. A further reason to account for the smaller number of female/

female patients may be the fact that, on the whole, the female is more primitive, less educated, and more conservative when it comes to availing herself of European medical attention. In point of fact, the female of Uganda is generally a well built, handsome woman, and in many cases a much better specimen than the male. Broadly speaking, her diet is as generous as that of the male under similar circumstances, for, although custom prohibits her such articles as eggs and chicken, there is no objection to meat, fish, etc. and in many instances the males do not eat eggs either. As has been mentioned before, it is difficult to obtain accurate information from the native about diet: he either considers such questions amusing and replies jokingly, or he becomes very grandiose. Questions to educated natives in various districts result in answers which can be relegated to two groups. The first group maintains that the female participates in the majority of the "treats", but as she is always stationed in the house, she has delicacies such as meat more often: the males from time to time go away on business of some sort, in many cases connected with the selling of their cotton, and while away, they do not buy expensive foods such as meat. The other group maintains/

maintains that there is little or no difference, but whatever happens, custom does not prevent the women-folk from eating the best available.

The question of diet will be dealt with elsewhere: the point is that in some years, as may be seen from the table, the percentage of female cases is lower than the males, but it must be stressed that it is difficult to obtain equivalent nett figures in the case of females. The difference disappears during 1931 when the ulcer incidence, in spite of little or no rise in total figures, rose considerably. 1931 was a very bad year for the native, probably more so than for Europeans in any part of the world. The African in Uganda had been greatly harrassed with an epidemic of plague during 1929 and 1930, which may have left its mark on the general health. Then came financial depression on top of his existing losses, and many retrenchments took place, prices went down and food had to be eked out. 1929 was a successful year, but plague was rampant and there was a slight rise in ulcer incidence. Continuation of this trouble may also explain the further rise in 1930, leading to the peak in 1931. It may also be seen that the rise also affects the female, when the real strain occurs. 1932 shewed a distinct improvement/

improvement and 1933 produced a very satisfactory crop of cotton, and albeit the price was low, conditions became much better. It is permissible to infer that the drop in ulcer figures may be one of the results of this recovery.

One may thus have reasonable right to conclude that, though females have a slightly less incidence, stress equalises this to a greater or less extent and one may also say that the female does not ail more than the male, even considering the strain on her endocrine system produced by such conditions as pregnancy and menstruation. Males are not any more liable to trauma than females, at least in times of peace.

TRIBAL INCIDENCE.

Tribes in Uganda do not differ in susceptibility if living under similar circumstances, especially as regards diet. The stranger, coming into a different province often must adapt himself to the diet of the residents, and such is the attitude of one tribe to another, that prices are raised to most unreasonable levels, and the stranger must accept these or go without. If he had been accustomed to meat at his own home, it generally becomes difficult for him to continue this delicacy elsewhere, at least, until he obtains employment, when once more he may be able to revert to his original diet.

As regard tribes in their own habitat, however, marked differences exist, and from reliable information - actually from medical officers who have been stationed among various tribes - it would appear that the BaKiga, living at altitudes in the South-west of Uganda of often 6000 feet, have a fairly high ulcer incidence, and they are generally poor. In the West Nile region, the Lugwara have a fairly high incidence; they are more vegetarian than the Aluru who eat fish, and the Aluru have not such a high incidence. The inhabitants of the Sesse islands have/

have a very low incidence, and the diet, as regards fish dried or fresh, and meat dried or fresh, is generous. The inhabitants of Komi islands do not eat animal flesh to any extent, and ulcers are fairly common. The natives around Mbale, in Eastern Province, are extremely liable to ulcers. According to Loewenthal, the incidence of the true tropical phagoedena is very high; the ulcers are much more extensive and sloughing than those found around Kampala, in Buganda Province, and many are stretcher cases. He expressed a very poor opinion of the diet, and suggests that this may be deficient in calcium and fat and protein. In Buganda, the Baganda (among whom the writer has lived for more than six years) seem to vary in incidence according to their financial circumstances, as chiefs, clerks, houseboys and such happily situated beings, are ulcer free. Others are not so happily placed. One fact seems to upset this theory is the incidence in children, often of good family, of any ages up to puberty. Many ulcers of class B or C (the distinction is purely according to origin) are found in children. Increased metabolic requirements associated with growth may explain this.

The BanyaRwanda, a very primitive and poor race/

race, immigrate to Uganda in large numbers. They find employment with natives who cultivate, and in Government departments and estates as porters, who hoe, carry loads, etc., or as sweepers who are not averse to dealing with refuse which the other natives consider degrading. These people if in employment, especially if allowed to keep livestock, often become bon viveurs, and ulcer incidence drops. As often happens, however, they fail to obtain employment in Government departments or private estates, and become destitutes, fall victims to all the diseases such as malaria, which they would not suffer in their own land where they live at very high altitudes, and are often admitted to hospitals starving, with typical emaciation or nutritimal oedema. The most appalling of all ulcers are found in this class. The Rwanda thus are an example of variation according to circumstances. The home circumstances of these people are not well known in Uganda, as they come from Belgian territory. It is known, however, that Belgian Rwanda is a famine country.

The BanyAnkole live in Ankole district of Uganda, reasonably high above sea level (over 4000 feet) and rather arid, scrubby country. The chief occupation/

occupation is the rearing of cattle. There are two tribes in Ankole, one, the "masters", keep the cattle, and employ the others to attend to them. These masters (the BaHima) used to eat meat and consume much milk in days gone by. The others, the BaAiru, were poorer and depended more on vegetables. TheBaHima did not suffer much from ulcerations, but the others did. Nowadays this is not the case, and it is stated that the BaHima are more intent on selling their meat and milk, and are far from immune to ulcers. Rinderpest in Ankole is also a factor worth considering. Cattle dying nowadays are not allowed to be consumed.

In Kenya, the Akikuyu are vegetarian and show a high incidence of ulcers, but the Masai, who live on meat, milk and blood, seldom suffer. The writer's enquiries in 1929 elicited the fact that the Masai occasionally suffer from infected spear wounds, but ulcers did not attract the attention during favourable times. Ulcers only appeared during lean times, when posho must needs be consumed. The Masai and Akikuyu have been investigated by others, particularly the late J.M.G. Henderson of the Rowett Institute.

The conclusions are thus suggestive of something/

something dietetic and thus will have to be repeated largely in another section. The dietary circumstances had to be suggested in this section with reference to tribal incidence.

SYPHILIS and YAWS.

As has been mentioned before, ulcers used often to be considered as gummata. No apparent benefit from bismuth, mercury and salvarsan therapy was noted except in such cases as were definitely of specific origin. A considerable amount of specific treatment used to be given to natives in response to a request, as the native invariably diagnoses his condition as "kabotongo" (syphilis or yaws) and has a complex with regard to the "impiso" (needle).

In 1929, 59 cases were selected so that in the majority of cases two ulcers could be obtained having a similarity of shape, size, colour of base, and consistence of base. That is to say, if an ulcer was oval, shewed a soft, red, healthy base and signs of epithelisation, and was say 3" x 2", it was controlled by another similar (to all intents) ulcer. If the base was hard, the edge raised, and the whole ulcer hopeless from the outset, another of similar nature was selected, and both were standardised by scraping. 28 cases were then treated with salvarsan substitutes and mercury, and 31 were not treated with these specific drugs, and were used as controls. There was no improvement noted in the cases treated in/

in excess of those not so treated. The average duration of an ulcer in the arsenical group was 58 days approximately: in the other group 35 days approximately. This does not mean that the arsenical remedies inhibited healing, but the difference was probably due to individual variation, as some cases fibrosed again and healed more slowly. The confusing feature about these cases is the fact that many shew a positive Kahn reaction, and thus a physician may be led away into making a convenient diagnosis of tertiary syphilis, and institute specific treatment. After a time it becomes obvious that the "gumma" is not progressing, and scraping is resorted to, with good results, In view of this, care has always been taken to obtain a special opinion in cases of doubt, and the results have been justified.

As an example of the frequency of positive reactions, 128 cases were tested in 1932, 88 bloods being from phagoedenic ulcer cases and 40 from non-phagoedenic cases. The weak positives (i.e. Kahn $\pm$ and +) amounted to 34; the strong positives (+ $\pm$ and + +) amounted to 22 in the phagoedenic group, i.e. total 56. There were 25 complete negatives only, and there was no record in 7 cases.

In/

In the non-phagoedenic group there were 17 weakly positive and 11 strongly positive bloods, i.e. total 28. 8 only were negative and there was no record in 4 cases.

TABLE/

TABLE 7

FLOCCULATION REACTIONS from BLOOD of 128 CASES during 1932

Clinical Type.	+ −	+	+ + −	+ +	−	No Record	Total
Phagoedenic	11	23	14	8	25	7	88
Non-Phagoedenic	3	14	4	7	8	4	40

In 1933, 112 cases were tested: 67 of these had phagoedenic ulcers, the remaining 45 being non-phagoedenic. Of the phagoedenic group, 27 were weakly positive, 23 were strongly positive, 12 were negative and in 5 cases there was no record. In the other group, 11 were weakly positive, 22 were strongly positive, 9 were negative and there was no record in 3.

TABLE/

TABLE 8.

FLOCCULATION REACTIONS of BLOOD from 112 CASES during 1933

Clinical Type	+ −	+	+ + −	+ +	−	No Record	Total
Phagoedenic	8	19	8	15	12	5	67
Non-Phagoedenic	3	8	7	15	9	3	45

DISCUSSION.

These results are in no way typical of ulcers, but are found in every other type of case, not only in Mulago, but largely over Uganda generally. The blood result does not affect the local or general condition in the slightest in the ordinary conditions with which patients are admitted. The figures for the venereal diseases department, naturally, have a different significance.

Most of the ulcer cases received no arsenical treatment at all, unless an occasional injection. The reasons for such an injection are twofold. In the first place, salvarsan substitutes do seem to have a tonic effect generally, and more so than corresponding doseage with liquor arsenicalis. Secondly, the psychical effect is considerable. It is by no means uncommon to see a native receiving an intravenous injection with a look of absolute confidence on his face, striving hard in many cases to conceal a gleeful smile. After receiving the "impiso" he walks away with, often, a completely changed, more cheerful expression.

ENDOPARASITES

No doubt the disappearance of Plasmodium, Necator, Ascaris, Taenia and the other parasites from Uganda would change the native for the better, but at the same time it is extraordinary how a native can harbour a museum, and retain it almost jealously, without collapsing by any means. Most of the cases of ulcer, whatever the sex, have endoparasites of some description. As every native, practically, fit or unfit, may likewise be liberally supplied with parasites, it is not a predisposing factor to ulcers alone. If the presence of helminthes, etc., however, is fairly constant for most of the community, then perhaps the addition of some other factor may precipitate ulcers, or some other illness. Assuming for a moment that dietary deficiency is a factor in the production of ulcer, then possibly the man with parasites, who has a poor diet, may succumb, whilst the man, also with these parasites, who has a good diet may not. It is not stated at this point that dietary deficiency is causal, it is only supposed for the sake of argument. Now, there seems to be little class distinction as regards parasites, for even chiefs harbour them, and if some do not, then certainly/

certainly many of their children do. As an example of the numbers of ulcer cases infected, in 1932 the same 128 cases shewed the following results:-

Of 88 phagoedenic cases, 15 had no parasites (Trichiuris trichiuris is disregarded); 10 shewed malaria parasites alone; 37 shewed helminthes only; 26 had both malaria parasites and helminthes.

The other 40 cases shewed no parasites in 12, only malaria parasites in 1, only helminthes in 10, both in 17 cases. The helminthes were often mixed, some cases shewing hookworm, Taenia, and Ascaris together.

TABLE/

TABLE 9.

PARASITIC "CONTENT" of 128 ULCER CASES TESTED during 1932

	Malarial Parasites	Helminthes	Both	None	Total
Phagoedenic	10	37	26	15	88
Non-Phagoedenic	1	10	17	12	40

As regards the helminthes, hookworms were present in approximately 96% of positive cases, Ascaris in 9% and Taenia in 11% Considering the number of people infected with worms, 11% is low for Taenia, and little meat can be eaten by ulcer cases, at any rate.

The 112 cases of 1933 were also tested. Of the 67 phagoedenic ulcers, no parasites were found in 9, 6 had malarial parasites only, 22 had helminthes only, 27 had both; there was no record in 3 cases. Of the 45 non-phagoedenic cases, 6 shewed no parasites, 2 shewed malaria parasites alone, 18 had helminthes alone, 17 had both, and there was no record in 2 cases.

TABLE/

TABLE 10.

PARASITIC "CONTENT" of 112 ULCER CASES TESTED during 1933

	Malarial Parasites	Helminthes	Both	None	No Record	Total
Phagoedenic	6	22	27	9	3	67
Non-Phagoedenic	2	18	17	6	2	45

Of the helminthes, hookworms were present in 98% of positive cases, Ascaris in 10%, and Taenia in 4%.

In conclusion, it may be said that these figures apply to all types of hospital cases, and not to ulcers alone. The presence of helminthes, malarial parasites, etc., however, may be a predisposing factor. Addition of other factors may bring about ulceration, absence of these other factors being compatible with a healthy skin.

As regards the females, 48 cases were tested during 1932 and 1933. 19 shewed helminthes alone, 4 malarial parasites only, 6 shewed both, 2 were negative, and there was no record in 17 cases.

CALCIUM and PARATHYROID.

While administering special remedies each case was made to be his own control. It has been stated already that it is difficult to find a case for control purposes for each ulcer under special treatment, as the control, though appearing similar, may yet have a slight tendency to fibrosis which is not at first apparent, but which may develop after standardisation by scraping, and thus not give a fair measure by which to judge the progress of its fellow. This so often happens that it has been found unsatisfactory to work on these lines. The judging of progress in human ulcers is not the easy task that animal experimentation may be. For instance, in testing the protective powers of a human serum against, say, the pneumococcus, it is known that the inoculation into mice of the pneumococcal culture will produce death, invariably, in a short time. Culture and serum may thus be inoculated into another batch of mice, and the results noted. The giving of, say, calcium to an ulcer, and having a similar ulcer for control, is not going to give results like this. Hence each case is his own control, as in this way problems as to difference in susceptibility, healing power/

power, etc. do not enter into the investigation to any great extent.

An ulcer is standardised by scraping, unless it is sufficiently clean, or recent, not to require this. A reasonable time is allowed on ordinary local treatment, usually until the base becomes red, and another week is added to judge if there is any skinning. During the whole time of observation the patent has the standard hospital diet, which is usually considerably better than that to which he is accustomed, and includes meat (or liver, if ordered), beans, ground nuts, plantain and sweet potato (or rice if preferred to plantain or potato), sugar cane and an occasional orange. If at the end of 2-3 weeks skinning is satisfactory, then no special treatment is required. If there is little or no skinning intravenous calcium chloride gr. xv in 10 cc. distilled water is given once or twice daily, and the progress noted by the end of another week. In successful cases there should be at least a growing skin edge then appearing, or, better, 1/8" new skin. If there is no result by the 10th day, parathyroid extract, gr. 1/10 t. d.s. a.c. is added by the oral route. Allowing for delay in absorption of a dried gland extract, two weeks more are allowed. In successful cases/

cases the skin edge should be marked in the previously negative cases, or should have advanced another 1/8-1/4" in the previously slightly successful (±) cases. In the event of success, this is usually noted by the tenth day, and certainly by the 14th after commencement of parathyroid therapy. Consequently in negative cases (-) special treatment is discontinued, as being unlikely to benefit the condition subsequently, and on account of expense. It is also discontinued in the successful cases (+, + ±) as the skin will advance per se after the gland therapy has supplied the necessary stimulus. The unsuccessful cases are generally found to have fibrosed or to have lost the healthy red base, and they are either:-

(a) Rescraped

(b) Given protein shock in the form of T.A.B. vaccine

(c) If T.A.B. produces a healthy base, they are grafted, to avoid useless delay.

It is certain that scraping and skin grafting will heal an ulcer in the shortest time, but this does not alter the fact that the underlying cause has still to be studied. Thus, no information can be gleaned/

gleaned from the time taken for each case to heal, as it is known that quite a large ulcer, if scraped and grafted at an early date, will be healed and out of hospital in 6-8 weeks and medium ulcers in much less. The average duration, in Mulago, of all such cases is about 6 weeks, even allowing for one or two cases requiring 3 or 4 months. In the cases of ulcers treated with calcium and parathyroid, time is disregarded for obvious reasons.

Previous to the use of intravenous Calcium i.e. previous to the publication of Loewenthal's results in 1932, Parathyroid was given with calcium lactate orally: with each 1/10 grain of extract gr. v Ca. lact. was given. In 1929 this gave very spectacular results on the selected cases (chronic, but with little fibrosis and deformity), and it is given when the stock of calcium chloride solution has run out. The results conform to type, are better than intravenous calcium alone, but rather less striking than the iv Ca. + parathyroid, the latter giving more speedy results, though possibly not a better result in the end. Some cases, also, were given iv. Ca. + parathyroid from the outset.

During the course of investigation results were graded as follows:-

No/

No improvement	-	
Slight "	+	
	-	
Definite "	+	
Marked "	+ +	but patient left hospital before complete healing, but well on the way.
	-	
Marked "	+ +	Patient remaining in hospital till completely healed and new skin firm.

In 1932, 54 cases received i.v. calcium alone. These were both phagoedenic and non-phagoedenic: 6 improved slightly, 12 definitely, 9 markedly, 27 failed. Including the slightly improved cases the proportion shewing benefit is thus 50% and, exclusive of the slightly improved cases, 39%.

9 cases received oral calcium and parathyroid: 4 definitely improved, 5 markedly improved. The proportion of amelioration is thus 100%, and there were no "slightly improved" results.

11 received intravenous calcium and parathyroid from the outset (i.e. after standardisation). 1 improved slightly, 4 definitely, 4 markedly, but 2 failed, and were found to have fibrosed, and were thus unsuitable, and should have been rescraped or treated with thyroid or T.A.B. first. The proportion, including/

including 1 slightly improved case, is 82% approximately: excluding this, 73% approximately.

3 cases received thyroid extract in addition to oral calcium and parathyroid. 1 was definitely improved, one markedly improved, and one failed, i.e. 67% amelioration. 2 cases received T.A.B. in addition to oral calcium and parathyroid. One failed, and required rescraping owing to fibrosis.

TABLE/

TABLE 11.

i.v. Ca. Alone		Oral Ca. & Para.		i.v. Ca. & Para.		Ca. Para + Thyroid		Ca. Para. T.A.B.	
-	27	-	0	-	2*	-	1	-	1*
+ -	6	+ -	0	+ -	1	+ -	0	+ -	1
+	12	+	4	+	4	+	1	+	0
+ + -	2	+ + -	1	+ + -	4	+ + -	0	+ + -	0
+ +	7	+ +	4	+ +	0	+ +	1	+ +	0
TOTAL	54		9		11		3		2

* Fibrosis.

The cases treated with oral parathyroid extract, after treatment with intravenous calcium, are recorded separately, in TABLE 12. Parathyroid is only added to those cases who are either negative as regards calcium alone, or who did not shew more than a + improvement. It is obvious that any + ± case does not require the addition of parathyroid. 18 cases are recorded, i.e. 15 negative to calcium alone; 1 slightly improved; 2 definitely improved.

Addition of parathyroid to the intravenous calcium in the first 15 cases resulted in 1 being further slightly improved, 2 definitely improved, 10 markedly improved: 2 did not improve and were found at further curettage to be fibrosed. The one case in the second class definitely improved further. Of the two cases in the third class, both improved markedly.

TABLE 12/

TABLE 12.

PARATHYROID ADDED to 18 CASES PREVIOUSLY on i.v. Ca.

i.v. Ca. Alone	Parathyroid Extract Added					
Benefit	-	$\frac{+}{-}$	+	$\frac{+ +}{-}$	+ +	Total
i.v. Ca. -	2*	1	2	6	4	15
i.v. Ca. $\pm$	0	0	1	0	0	1
i.v. Ca. +	0	0	0	1	1	2
						18

*Fibrosed.

Reference to the above table shews that the addition of oral parathyroid in most cases causes a further improvement, as evidenced by increased epithelisation, or, in these cases in whom no epithelisation resulted, from the administration of calcium alone, then the slight or marked appearance, and spread of the skin edge.

In 1933, similar observations were continued. 44 cases received intravenous calcium alone. There was no change in 9: 12 improved slightly: 19 definitely: 4 markedly. Including the 12 slight improvements, the proportion of benefit is thus 81% approximately: minus these 12, 57% approximately.

14 cases received calcium and parathyroid orally. Of these, 1 failed, 1 was slightly improved: 4 improved definitely: 8 improved markedly. Excluding the 1 slightly improved case, the proportion of benefit is 86% approximately.

12 cases received intravenous calcium and parathyroid together, from the outset. 3 definitely improved: 6 markedly improved, 3 failed. Two of these healed completely with the same treatment plus injections of T.A.B. intravenously, and one was grafted before fibrosis further increased.

TABLE/

TABLE 13.

70 ULCER CASES TREATED with CALCIUM, PARATHYROID and T.A.B. DURING 1933

i.v. Ca.		Oral Ca. + Para.		i.v. Ca. + Para.		Ca. + Para. + T.A.B.	
Result	No.	Result	No	Result	No.	Result	No.
-	9	-	1	-	3*	-	0
+ -	12	+ -	1	+ -	0	+ -	0
+	19	+	4	+	3	+	0
+ + -	3	+ + -	1	+ + -	5	+ + -	0
+ +	1	+ +	7	+ +	1	+ +	2*
TOTAL 70	44		14		12		2

* Fibrosis. In 2, cleared up with T.A.B. as per table.

In the cases treated with intravenous calcium, 16 were later given parathyroid. Of these, 7 failed and 9 had shewn a definite improvement. Reference to TABLE 14 shews that 2 received no benefit, but that 5 markedly improved in the calcium negative section, whilst in the other class, 4 definitely progressed further, and 5 did so markedly.

TABLE/

TABLE 14.

16 CASES RECEIVING PARATHYROID after i.v. CALCIUM

i.v. Ca. Alone	Parathyroid Extract Added					
	−	$\frac{+}{-}$	+	$\frac{++}{-}$	++	Total
i.v. Ca. −	2	0	0	3	2	7
i.v. Ca. +	0	0	4	3	2	9
						16

4 female cases were treated during 1932 with calcium and parathyroid after other remedies had been tried. All cases healed (+ +).

3 female cases treated with calcium and parathyroid in 1933 likewise healed. These cases are few, but are of interest in that they were treated independently, by another officer, and thus support previous findings.

During 1934, a different procedure was adopted. Cases were given calcium intravenously, previous to scraping, in order to investigate Loewenthal's claims:-

(a) that odour was reduced;

(b) that the necessity for operation was reduced.

13 cases given intravenous calcium therapy shewed 4 successes (2 definite; 2 marked), but 9 were failures. One of these failed cases promptly healed after taking oral calcium and parathyroid. Two received no further treatment except local pressure, and six were curetted. Of these, four did not benefit in the very slightest and subsequently two of them received everything conceivable and still remained unhealed. One, however, promptly reacted to calcium and parathyroid and healed, whilst the fourth healed with elastic pressure/

pressure, there being a hard oedema of the affected leg.

LOEWENTHAL'S[13] second claim thus does not receive much support, but it so happens that the cases in his district were stated to be more acutely phagoedenic, fibrosis thus probably being less marked His first claim receives support: odour was reduced.

DISCUSSION

These results indicate that there is a definite benefit resulting from the administration of calcium intravenously. 15-30 grains of $CaCl_2$ daily was the dose given. The allowance of calcium, as CaO in the food daily, is usually stated as being about 1 gramme, which gives sufficient margin in case of non-absorption, taking the minimum required absorption as being 600 mgs. CaO. The 15-30 grains (1-2 grammes) of $CaCl_2$ introduced directly into the bloodstream in a presumably ionised form gives a more than adequate supply of calcium to the system, but does not give rise to hypercalcaemic symptoms. This does not mean that there must be a calcium deficiency in the absence of such symptons, as these only result if/

if the calcium level in the blood is persistently high. The intravenous calcium causes a transient rise in the serum-level, the calcium quickly finding its way to the tissues (local pain in the ulcer often occurs a short time after an injection). The beneficial effect of intravenous calcium is difficult to interpret, therefore, and it must be assumed that the transient rise in the serum calcium level is not so important as the possible adjustment in the quality of the calcium. When it is remembered that 40% of the serum calcium is indiffusible, and only 20% of the remaining diffusible calcium is ionised, it is obvious that marked alterations may occur in the internal balance without there being anything markedly lacking when the total calcium is estimated. At the same time, the benefit derived from such administration of $CaCl_2$ <u>does</u> suggest some maladjustment. It may be stated with some degree of safety that parathyroid excess does not exist. Likewise, parathyroid activity in the presence of a calcium deficiency might result in bone mobilisation to an extent likely to produce appreciable changes. No rarifaction of bone is noticeable in skiagrams of average cases with fractures, and osteitis fibrosa has never been encountered. There is no evidence of/

of hyperparathyroidism, e.g. deposits of calcium phosphate in blood-vessels, such as was found by McGOWAN[14] to follow administration of parathormone to laying hens. Renal calculus is not common. The important issue therefore is whether the parathyroid in these cases of ulcer is incapable of keeping the calcium adjustment within reasonable limits. The superiority of parathyroid and calcium to calcium alone might be explicable on the grounds that a more lasting effect on the calcium level, or calcium balance, is produced. In spite of the consensus of opinion being against the activity of parathyroid when administered by the oral route, the evidence in this instance suggests otherwise, and its efficacy is admitted by others (DICKENS and DODDS[15]: SCOTT[16]).

Besides the influence of the parathyroid on calcium, by prolonging the effect of this orally or intravenously on the serum, the parathyroid may have other factors. Judging by the results of its administration to ulcer cases, there appears to be an influence exerted on ectodermal structures. Clinically it has long been believed that in parathyroid deficiency, brittle nails, affections of the hair, and cataract are commonly found, and these/

these all occur in Uganda. Such a factor may be undamaged by the juices of the alimentary tract.

The connection of the parathyroid with nitrogenous metabolism has been investigated (BERKELEY and BEEBE[17]; PATON and FINDLAY[18]) and the association of increased guanidin with tetany cannot be ignored entirely. A nitrogenous metabolism factor may exist.

EASTLANDS, EVERS, and THOMSON[19] reported a growth retarding factor found in extracts of parathyroid, but this is believed to occur in other tissues also. It thus does not seem permissible to associate the parathyroid entirely and exclusively with calcium regulation, and further work is indicated. Certain conditions, in which no apparent serum calcium level disturbance exists, are yet found to benefit from calcium and/or parathyroid therapy.

SHAMBERG and BROWN[20] found that in urticaria the calcium level is normal, as it is in other dermatoses, yet these conditions benefited from calcium administration.

SCHWARTZ and LEVIN[21] quoted figures for calcium, and concluded that no significance attached to decreased serum calcium unless marked.

In/

In acne, eczema, psoriasis, furunculosis, and folliculitus barbae, a noticeable decrease of serum calcium wasfound in several cases, who improved with parathyroid and calcium, with an increase in the serum calcium level.

CORNBLEET[22] recorded prompt benefit in 21 cases of lichen urticatus after calcium and parathyroid, the latter by injection of parathormone (Collip).

COOPER[23] found that in parathyroid deficiency the hair may cease to grow for months (without necessarily becoming scant) or there may be alopecia, dystrophic changes in the nails and teeth; pigment anomalies, and chronic ulceration occur in the skin.

KLAUDER and BROWN[24] reported that calcium (and potassium) ratios are normal in many skin conditions which yet improve on calcium.

There is thus a possibility of an "ectodermotropic" factor in the parathyroid, which may be deficient:-

(a) as the result of general deficiency of the whole gland, somehow produced by faulty diet and debility. In this case there may result a fall in the serum calcium, with or without a rise in the inorganic phosphorus, the subject approaching close to a state of latent tetany.

(b)/

(b) as a result of partial deficiency of the gland, possibly connected with nitrogenous metabolism, and not apparently affecting the calcium regulation, at any rate sufficiently to be noticed by estimation. Such might decrease the ectodermal factor.

The benefit of the intravenous calcium, from this angle, would be explicable on the basis that the supplying of ionised calcium direct to the blood would lessen the need of the parathyroid to be constantly working overtime on calcium regulation: it would have more chance to attend to the ectoderm.

As regards the first possibility, the addition of parathyroid and calcium to that already extant would help the gland to maintain the calcium balance; this seems a satisfactory explanation of the marked response to treatment.

SERUM CALCIUM and PHOSPHORUS LEVELS IN ULCER CASES.

In normal subjects the serum calcium and phosphorus figures remain fairly steadily within certain limits, i.e. the calcium between 9.5 and 10.5 milligrammes per cent, anything below 9 and above 11 being considered abnormal. The phosphorus is more difficult to place, but anything from 1.5 to 5 mgs. percent/

percent is considered normal. Perhaps such a wide variation is permitted owing to the difficulty of preventing alteration after withdrawal of the blood. The inorganic phosphate begins to increase in a matter of a few hours after withdrawal of the sample owing to hydrolysis of phosphate esters. In all examinations carried out in Uganda, the tests were performed a short time after collection: if there was a delay, then the sera were either placed in the ice chest, or the initial precipitation done at once, the actual estimation being carried out later. For instance, in the case of the calcium, the ammonium oxalate was added at once, and as mixtures were always allowed to stand overnight, there was probably little chance of fallacy. Precipitation with the trichloracetic acid was also done at the same time. With regard to the phosphate level, 5 mgs. percent is considered rather high here, the normal range being taken as 1.5-4 mgs. percent.

In all cases, the serum calcium was estimated by the method of Kramer and Tisdell; no sera were ashed. The phosphorus was estimated by the colormetric method, and in the high phosphate sera, a precipitate was often observed with the ammonium molybdate/

molybdate.

Compared with the levels found in presumably normal natives, the serum calcium of ulcer cases is often low, and there is a tendency to a high phosphorus. In cases considered to fall withim normal limits, the tendency of ulcer cases is to have a low-normal calcium level. In ulcer cases, there is a much greater tendency to fluctuation than in normal subjects. 106 cases are recorded in this section examined during 1933 and the blood was withdrawn from these at a certain time, i.e. a considerable time after the last meal, and near the time of the next meal, so as to avoid estimation coinciding with too recent absorption.

TABLE 15 shews the findings in 57 phagoedenic cases. TABLE 16 shews the findings in 49 non-phagoedenic cases.

TABLE/

TABLE 15.

Serum Ca. & P. of 5% Cases of Phagoedenic Ulcer (mgs. %) examined during 1933 (fasting).

LOW			NORMAL			HIGH		
No.	Ca.	P.	No.	Ca.	P.	No.	Ca.	P.
1	5.5	4.5	1	9.0	2.5	1	11.7	4.4
2	6.3	11.2	2	9.0	3.4	2	11.9	2.0
3	6.6	5.8	3	9.1	4.7	3	12.0	4.6
4	7.6	5.6	4	9.1	1.4	4	14.2	3.2
5	7.9	3.3	5	9.2	3.6	5	15.0	2.1
6	8.1	8.2	6	9.3	4.3	6	16.1	10.4
7	8.2	2.8	7	9.3	4.6	7	18.0	3.2
8	8.2	2.7	8	9.3	3.0	8	19.0	3.4
9	8.2	1.8	9	9.3	2.0			
10	8.3	3.0	10	9.4	4.8			
11	8.3	2.2	11	9.4	5.4			
12	8.4	2.4	12	9.5	4.3			
13	8.6	4.0	13	9.5	2.9			
14	8.7	4.5	14	9.6	2.3			
15	8.8	4.2	15	9.7	2.0			
16	8.9	1.9	16	9.7	4.1			
17	8.9	3.3	17	9.7	3.7			
			18	9.7	4.7			
			19	9.8	4.3			
			20	9.9	7.9			
			21	9.9	2.8			
			22	9.9	3.5			
			23	10.0	4.6			
			24	10.0	2.2			
			25	10.4	4.5			
			26	10.5	2.9			
			27	10.7	4.2			
			28	10.7	4.7			
			29	10.9	3.4			
			30	10.9	3.4			
			31	11.0	4.0			
			32	11.3	5.7			
Aver-age	8.0	4.2	Aver-age	9.8	3.8	Aver age	14.7	4.2

Proportion =	Proportion =	Proportion =
30% Low	56% Normal	14% High.

TABLE/

TABLE 16.

Serum Ca. & P. of 49 cases of Non-Phagoedenic Ulcer (mgs. %) examined during 1933 (fasting).

LOW			NORMAL			HIGH		
No.	Ca.	P.	No.	Ca.	P.	No.	Ca.	P.
1	6.3	2.9	1*	9.1	5.0	1	11.9	2.8
2	6.4	7.8	2	9.1	2.8	2	13.3	5.4
3	6.7	6.0	3	9.1	2.5	3	15.0	3.4
4	7.0	5.0	4	9.2	3.8	4	15.0	4.0
5*	7.6	2.5	5	9.3	2.3	5*	15.4	2.8
6	7.6	2.4	6	9.3	6.0	6	24.1	2.7
7	8.2	5.3	7	9.4	5.0	7§	70.4	1.5
8	8.3	6.0	8*	9.6	2.4	8+	87.0	1.5
9	8.3	2.7	9	9.6	2.0			
10	8.3	2.0	10	9.6	1.9			
11	8.5	3.5	11	9.7	4.0			
12	8.5	3.3	12	9.8	3.5			
13	8.6	3.8	13	9.8	4.0			
14	8.7	6.3	14	9.9	3.3			
15	8.7	2.8	15	10.0	2.6			
16	8.8	3.0	16	10.0	3.1			
17	8.8	2.8	17	10.0	3.4			
18	8.8	3.0	18	10.1	5.6			
19	8.9	3.3	19	10.1	5.6			
20	8.9	2.2	20	10.6	2.9			
			21	11.1	10.7			
Average	8.1	3.8	Average	9.7	3.9	Average	15.8	3.5
Proportion = 41% Low			Proportion = 43% Normal			Proportion = 16% High.		

* Women §70.4/1.5 > 10.0/4.6 > 8.6/9.4 → Tetany) *
+87.0/1.5 > 10.6/3.4)

*Excluded from average. High Ca. probably due to protein.

DISCUSSION/

DISCUSSION.

The figures in TABLE 15 shew that in the phagoedenic group of 57 cases, approximately 30% have a low calcium level, which proportion could be augmented at the expense of the "normal" group. Some of the figures are so low as to suggest that these patients were near the border of latent tetany. The absence of tetany in an active form in ulcer cases with such low calcium levels goes to prove that the calcium level, within limits, matters little in the causation of tetany; it is the amount of drop in level which affects the nervous system. Thus a man may drop from 7 to 5 mgs. % without going into tetany, provided that he has been accustomed to a low level. Another man, accustomed to a high level of, say 12. mgs. % will develop tetany if the level suddenly drops to 7 or 8 mgs. %. The phosphorus level of 10 of the above 17 cases appears to be about normal, but is rather high in a number of the other 7. The highest phosphorus figure is shewn by case number 2 of the low level series, and is 11.2, being associated with a calcium of 6.3 mgs. %. The lowest phosphorus figure (No. 9) is 1.8 mgs. %, occurring with a calcium of 8.2 mgs. %. Number 1 with a calcium of

5/

5.5 mgs. % shews a phosphorus of 4.5, i.e. not abnormal according to many standards. Number 4 shews Ca. 7.6 P. 5.6, the P. being slightly raised. There thus seems little constant relationship between the calcium and phosphorus in this series of 17 cases. The results are too diverse for any such relationship to be apparent.

In 32 out of the 57 cases, i.e. 56%, the calcium content falls within normal limits, but the dividing line between the highest and lowest permissible level has been generously stretched, and extends in this instance from 9 to 11.5 mgs. %. It is evident that only 8 are between 10 and 11, only 2 are 11 or over, and the others are all below 10, with a fair proportion below 9.5 mgs. %. The phosphorus figures tend to be a high-normal or slightly above the highest level permissible.

In 8 cases, i.e. 14%, the calcium values are high, and above 11.5 mgs. %. In European practice, the highest level is stated as being 18 in some instances, up to 24 in others, but in exceptional cases. One of the present series is 19 mgs. % for calcium. The phosphorus is perfectly normal.

The calcium-phosphorus levels are varied, number 7 shewing Ca. 18 and No. 8 Ca. 19, No. 4 Ca. 14/

14.2, and there seems to be no disturbance of the phosphorus level in either. In the case of No. 6, however, with a calcium of 16.1, there is a phosphorus of 10.4.

The figures in this series do not confirm the findings of FRAZER[25] (working with sheep and rabbits), namely that there is a reciprocal relationship between the serum calcium and phosphorus, one rising as the other falls, and vice versa. It is, however, stated by Frazer that the relationship will not be clearly shewn in cases where there is a deficiency of calcium or phosphorus in the diet, or where conditions favouring absorption are subnormal. It so happens that the diet in these ulcer cases is extremely suspicious.

In 49 non-phagoedenic cases, as recorded in TABLE 16, 41% shew a low calcium level, 14 are normal as regards phosphorus and the remaining 6 shew a raised phosphorus.

21 cases, i.e. 43% shew a calcium which falls within normal limits, but 14 being below 10 mgs. %. 6 cases exhibit a rise in phosphorus, assuming as normal 1.5 to 4 mgs. %, but again there is no evidence of reciprocal relationship.

8 cases, i.e. 16%, have a high serum calcium/

calcium. The phosphorus is raised in only 1 case.

Two cases give very startling figures as regards calcium, and are obviously due to something else. The "calcium" is beyond saturation point to begin with, and as the serum was not "ashed" the precipitate, which came down at once with oxalate, must have been due to protein which, of course, will use up permanganate during titration.

No. 8 was actually a complicated "yaw", and may have had a high globulin. His second test, a week later, with hospital diet, was calcium 10.6, phosphorus 3.4 mgs. %.

No. 7 was an educated, "private ward" case, whose diet was said to have been reasonably good. Actually, he was poor and unable to pay at private ward rates, but too proud to accept free treatment. The calcium figure may have been due to globulin. With so many affections as chronic malaria, which notably raises the proportion of euglobulin, it might be interesting to compare malarial sera with normal sera as to their effect on permanganate.

The subsequent history of this man is noteworthy. On the assumption that bone-mobilisation might explain some of the increase in calcium, intravenous calcium chloride, gv. xv daily, was given for one/

one week. The serum, examined at the end of this period, shewed calcium 10.0, phosphorus 4.6. Calcium therapy was discontinued, as the ulcer had progressed markedly. One week later the serum calcium was 8.6 and the phosphorus had risen to 9.4 mgs. %. Next afternoon he went into tetany. His relatives gave a history of previous attacks.

This case, incidentally, is an example of a certain amount of reciprocal relationship between calcium and phosphorus. He may have been keeping his calcium level within reasonable limits by bone and teeth mobilisation. Other cases with a high calcium may be doing likewise. Loss of dental enamel is common in Uganda. The coloured races are often credited with good teeth. Local experience does not always bear this out. PAWAN and CAMPS-CAMPINS[26] quoted calcium figures for various conditions. Their normal average was 10.7, maximum 12.2, minimum 9.5 mgs. %. Their ulcer figures shewed an average calcium of 10.2, maximum 13.0, minimum 8.4 mgs. %. They found that ulcer cases, if otherwise healthy, did not show a calcium figure of less than 10.0 mgs. % but if these cases were debilitated, the calcium was low.

These figures, though higher than in the Uganda cases, yet lend support. As the writer has

also/

also been in Trinidad, B.W.I., where Pawan carried out these investigations, it can be stated that the native diet there is superior to that consumed in East Africa, which may explain the higher West Indian figures.

In addition to the beneficial effect of calcium and parathyroid on the clinical progress, an added proof of absorption may be found in the effect of this combination on the serum calcium. 7 cases are shewn in TABLE 17, which were treated with calcium and/ or parathyroid.

TABLE 17/

TABLE 17.

7 ULCER CASES. EFFECT of CALCIUM and PARATHYROID on ULCER, and SERUM Ca. & P.

Card No.	Initial	Ca.	P.	Remedy	Benefit	Effect on Ca.	P.
108	Initial	14.2	3.2	Para & Ca.	+ + −	12.0	3.1
1079	"	6.4	7.8	" " "	+ +	14.0	3.0
1319	"	9.4	3.1	i.v. Ca.	+ +	10.0	2.2
4030	"	9.9	7.9	Para. & Ca.	+ +	10.2	3.1
4119	"	8.8	4.2	" " "	+ +	9.1	3.2
4547	"	7.9	3.3	" " "	+ +	10.5	4.4
5393	"	7.9	2.8	" " "	?	9.4	3.7

With one exception, the calcium is raised, and in the one exception it is lowered, but to a more reasonable level, i.e. "regulated". With the exception of numbers 4547 and 5393, a certain amount of reciprocal relationship between calcium and phosphorus is shewn.

The effect of the pure parathormone on the serum calcium is, of course, known, but these figures, apart from the results noted on the progress of ulcers, go to shew that the active principle of the dried extract itself is absorbed when taken orally. This, in view of the oral absorption of other extracts, in particular thyroid, is suggestive.

DIET.

Under the heading "TRIBAL INCIDENCE" certain tribes were mentioned with regard to ulcer incidence and, of these, some require mention again.

THE LUGWARA.

This is a Nilotic tribe. Meat does not seem to enter much into their dietary. They partake of a diet which is largely vegetarian. Ground nuts and beans may be eaten. It is not known how often. Ulcers are common among these people.

THE ALURU.

Fish is largely consumed. Ulcers are not so common as in the neighbouring Lugwara. These two tribes, like most Nilotic people, consume a fair amount of maize (meal and cobs) and Nilotics are very partial to a kind of wild spinach, called dodo, which is known to be rich in vitamin A.

THE BASESSE.

The Basesse, who inhabit the Sesse Islands, a group of islands in Lake Victoria, are a fishing people. Dried fish and animal flesh are eaten almost daily. Ground nuts are not cultivated on the Sesse Islands/

Islands, as these are stolen by monkeys. Beans may be eaten. Ulcers are not common.

THE MASAI.

The Masai, a hunting tribe in Kenya, were formerly the terror of East Africa. They live in the Masai reserve and tend cattle. They live almost exclusively on meat, milk, and blood. Ulcers are uncommon. Constipation and rheumatism are common.

THE KIKUYU.

A Kenya tribe, are largely vegetarian, like Uganda tribes. A large proportion of the diet consists of maize (posho). Ulcers are common.

THE BAGANDA.

The Baganda, and kindred tribes throughout the Northern, Eastern, Western, and Buganda provinces of Uganda, have a great leaning towards vegetarianism. This may be a matter of preference, or a matter of choice, or a matter of necessity. For instance, many Baganda would be unhappy without matoke, which is cooked plantain, eaten in large bulk, and of the consistency of mashed potato. The same may be said of sweet potatoes, which are consumed in a bulk that is almost incredible (a single potato/

potato would give the European a considerable feeling of distension). Ground nuts and beans may be eaten but quite a proportion of natives do not eat much of these, possibly a matter of taste.

Cheapness is a great factor. The native grows his own food, and so his diet costs him little, actually living on sweet potatoes, plantain, and cassava, a native, who does not grow his own, can still live at the rate of 20-30 cents daily. Meat is an infrequent delicacy, and is one of the banquet dishes. Many natives never eat meat at all, others twice a month, perhaps, whilst once a week is a practice indulged in only by those whose status is well into the middle classes.

Eggs do not seem to have any place in the native dietary. Custom is largely responsible for this. It is a pity, actually, as eggs are very cheap as compared with meat and fish. Every peasant has poultry, which are self-supporting. The eggs are sold to Europeans at 100 for one shilling in up-country districts. In townships the native is very crafty, however, and sells eggs at a much higher price but the fact remains that to the native himself, eggs are cheap, were he only to eat them. The same applies to the birds themselves - in country districts five/

five can be purchased for 1/-, and it is thus a pity that the native does not eat them himself.

Meat is certainly not disliked by the native, because the more affluent he is, the more frequently is meat partaken of. Thus, a chief or schoolmaster, native doctor, well paid clerk, and so on, eat meat every day. Unfortunately, these form only a small proportion of the whole populace, but they certainly do not suffer from ulcers, which are the lot, almost exclusively, of the lower classes.

The fact that ulcers are not common in tribes or individuals who consume flesh, beans, and ground nuts, suggests that the dietary is largely the seat of the trouble, and the points which seem to require investigation chiefly are the constituents, mineral and organic, of the various foods in common use. Meat, beans, and ground nuts suggest a sufficiency of fat and protein. The other foods suggest an insufficiency of these foodstuffs. The carbohydrate content can be ignored, as it is obviously sufficient. Protein may concern the parathyroid and so reflect on the calcium balance in the serum. Vitamins A and D require consideration, and certainly calcium and phosphours, and possibly pigments/

pigments.

THE RÔLE of FAT in the DIET.

Fat seems to aid calcium absorption. It is an essential constituent of animal cells; it is a convenient source of energy; it is probably the best stimulent to the biliary system; it is the source of cholesterol, which, owing to a small amount of ergosterole present in impure cholestrol, is a source of vitamin D.

As a source of energy, it is doubtful if fat plays much part, as the large bulk of carbohydrate ingested by the native ensures ample conversion of this foodstuff into fat for storage purposes. If nuts are eaten, ample fat is ensured, the ground nuts containing a high proportion.

As a source of vitamin A, the fat must be of animal origin, although vegetable fats contain some vitamin D. The native is much more likely to obtain his vitamin A from green vegetables, or from seeds. As regards green vegetables, much of the dietary is found to be lacking in these, as not all consume spinach regularly. Regarding seeds the sim-sim seed is frequently eaten, and is probably a likely source. Thus one or other of these articles is/

is necessary, as the root vegetables usually used are lacking in vitamin A (although the South African sweet potato is said to contain an adequate amount).

THE RÔLE of PROTEIN in the DIET.

A high protein diet stimulates the excretion of bile-salts. The absence of a sufficiency of protein might conceivably affect adversely the digestion of fat, if present in excessive amount. Fatty acids may bind calcium and prevent its absorption. Protein is the sole source of nitrogen for purposes of tissue repair, and the better the protein, the better this repair will be. Only two first class proteins are obtainable from vegetables, and these are pea-nuts and beans. It is a source of energy, but in the absence of adequate amounts in the diet the native probably relies on carbohydrate, of which there is an excess, and which is a source of his fat also. The carbohydrate probably spares his protein waste, but a certain amount of nitrogenous excretion must needs occur, and this varies as the quality of the protein ingested, hence the importance of a first-class protein, if a degree of deficiency exists.

Protein/

Protein stimulates metabolism.

The essential amino-acids are of paramount importance. The body is able to prepare certain amino acids synthetically if fatty groupings are available. The native, whatever the protein deficiency in his diet, can always form alanine and glycine from carbohydrate products plus ammonia. Other amino acids must be present in ingested protein, however, e.g. tryptophane, tyrosine, cystine, lysine. These are obtainable to an almost constant extent from animal proteins, but when the source of protein is the vegetable kingdom, there is always that feeling of uncertainty which is disturbing. The glutein of wheat seems satisfactory, but wheat is not a native food, and in the absence of knowledge as to the exact proteins present in Uganda vegetables, it can only be hoped that similar proteins exist. The protein of potatoes is spoken highly of as a biologically sound protein. This does not mean to say that the sweet potato of Uganda possesses similar properties: it has been impossible to perform qualitative analyses of local foods. Maize is largely consumed by many tribes, particularly the Nilotics, and the Akikuyu in Kenya. The Baganda are very partial to corn-cobs (kasoli) but this/

this is only one entity in their dietary. As the zein of maize is deficient in Tryptophane, which is absolutely necessary for life, and Lysine which is necessary for growth, it is obvious that death will rapidly follow the exclusive use of this cereal. It is certain, therefore, that a minimum of other proteins is present in local foods - at any rate, a minimum for existence, although not necessarily for robust health. The addition of milk would supply an abundance of valuable amino-acids, but, unfortunately, it is not consumed to any extent at all except by the Masai, and, perhaps, the BaHima; thus a valuable source of calcium, apart from amino-acids, is lost.

With regard to maize, it is hoped that the above remarks will serve as a warning against the too liberal use of maize in prison diets. The protein of peanuts (the Uganda groundnuts) contains, undoubtedly, the essential amino-acids, and the peanut protein is considered to rank high in biological value, the fat also being a reliable source of vitamin D. The soya bean contains protein of sound biological value; the Uganda native bean (mutike) may be akin to the soya bean, and has a high protein content. If the native includes these frequently in his/

his food, a sufficiency of essentials is assured. As it is by no means certain that he always does (certainly ulcer cases do not) there is no absolute assurance that he is obtaining any more of these essentials than a minimum, and the percentage of protein in his other articles of diet is usually low, as will presently be indicated.

CALCIUM and PHOSPHORUS and the VEGETABLE DIET.

These are derived from animal tissues and from vegetables. As regards vegetables, the content of soil does not appear to be of much import, as vital action will enable absorption to occur. That is to say, if a deficiency exists, the plant will increase its root capacity to ensure adequate absorption. In the event of the soil being unsuitable for increased rooting, crops would not be planted there as the resultant poor produce would not be purchased. The amount of mineral contained by the plant, however, is not necessarily in the proportions suitable for human consumption, whereas the proportions of calcium and phosphorus in animal tissues are balanced to human needs, the animal having taken the trouble, during/

during life, to adjust this.

Man can probably only effect this adjustment with considerable trouble. For instance, it is from the herbivora that man obtains his animal food. Herbivora are adapted to a vegetable diet, the alimentary canal shewing various modifications for, and employing bacterial action in, the digestion of foods rich in cellulose. It is thus better for man, with no special adaptations for coping with a purely plant diet, to include animal substances in his fare. Even taking into account biologically good protein, as found in nuts and beans, the alimentary canal has much work in reaching the essential constituents, as cellulose must first be dealt with. In many foods the protein content is small. In order to make good this paucity, added bulk must be ingested. This is overcome, as the native has acquired a distensibility of the stomach which can accommodate a bulk much greater than could be stored by the European. The bulky vegetable diet is unlikely to call forth a secretion of acid and pepsin to the same extent as would a smaller, more balanced meal, and the acid will tend to be inadequate to deal with any marked excess of calcium. As has been shewn by McGOWAN[27] the most important single factor controlling/

controlling the absorption of calcium and phosphorus seems to be gastric acidity. Any excess of calcium not dealt with by gastric acidity will combine with the phosphorus, being precipitated as $Ca_3(PO_4)_2$, and so the phosphorus may be lost, the $Ca_3(PO_4)_2$ being excreted in the faeces. As in the Uganda diets the calcium is not by any means excessive, probably there is enough acid to cope with it, but there is a large excess of phosphorus, which creates an imbalance which becomes of importance further down the tract.

In the event of deficiency of vitamin D, imbalance of phosphorus and calcium means a loss of one or both, an imbalance of more than 4 to 1 either way being incompatible with absorption, as ionised calcium, in the form of $CaHPO_4$, is not formed. If calcium is in excess, it precipitates the phosphorus as $Ca_3(PO_4)_2$. If phosphorus is in excess, then it precipitates the calcium, tricalcium phosphate again resulting, and this is excreted in the faeces. In the presence of vitamin D in adequate amounts, considerable degrees of imbalance are tolerated. Vitamin D thus increases the absorption of calcium and phosphorus from the alimentary tract (HARRIS and INNES[28]).

Great imbalance, due to phosphorus, exists in/

in Uganda foods, and as the calcium may be low in these foods, it must be assumed that all is absorbed, owing to the action of vitamin D. The tropical sun activates the natives' own ergosterole, which ensures adequate vitamin D, even if such is lacking in the diet. Assuming the absorption of calcium and phosphorus, ingested along with the bulky diet usually consumed, then, in view of the beneficial results of calcium injections, it might be reasonable to expect that more calcium could be absorbed if added to the diet in sufficient quantity to balance the phosphorus whilst yet being dealt with by the gastric acidity. The addition of calcium lactate, up to gr. v. t.d.s. seems a reasonable amount which could to advantage be added. It is doubtful if such a small amount would have much effect on the serum calcium level, at least for some considerable time, but in conjunction with parathyroid, it has been already indicated, an effect is produced. The effect of calcium lactate, alone, on ulcers has not been discussed, as it has not been found to produce any change quickly enough to be separable from other factors such as the better hospital diet. As a prophylactic it has a different significance, naturally. Further, as has also been stated, the additional/

additional benefit derived from the addition of parathyroid alone to intravenous calcium suggests that any benefit resulting from oral parathyroid and calcium lactate is not due to the calcium alone.

Before leaving this subject of calcium, phosphorus, and the vegetable diet, it is advisable to follow the vegetable diet further. A bulky meal is ingested: symptoms in cases of gastric and duodenal ulcer cases, and in the dyspepsia of ankylostomiasis, indicate that no lag occurs in the action of the pyloric sphincter. The native stomach thus seems to empty in the usual period. The native has usually two meals daily, one at midday and one in the evening. This should allow sufficient interval to ensure both being digested, but the above findings indicate that probably much food is passed on. As the various essentials are only in a sufficiency when a large bulk is consumed, part may be lost. As is aptly stated by SAMSON WRIGHT[29]:

> "Cellulose which is ingested passes out unchanged, and substances which are enclosed in a cellulose wall escape digestion and absorption. The increased bulk of this undigested residue stimulates intestinal peristalsis. The passage of the food through the bowel is therefore quickened, and the digestive ferments have insufficient time to exert their full action."

The native defaecates twice daily, and the stools/

stools are bulky. Thus more of his food is undigested, and some of his much-needed nitrogen is not utilised

VITAMINS A and D.

Vitamin A is present in animal fats, in the embryo of seeds, and in green vegetables. It is said to be absent from root vegetables, but is found in South African sweet potatoes, and may thus be present in East African sweet potatoes also. In vitamin A deficiency there is increased liability to various infections. It is assumed that the native obtains adequate amounts of this vitamin, as rarely is xerophthalmia found outside prisons. In Luzira prison, Kampala, xerophthalmia crops up from time to time, and LOEWENTHAL[30] found an acne-like skin condition in prisoners, which he termed perifolliculitis. Night-blindness was often found in association, and so vitamin A deficiency has a definite connection with the skin. That it plays no part in the causation of ulcer is suggested from the fact that ulcers are never found in long-term prisoners, who have a generous diet, including meat.

Vitamin D is obviously not lacking. The native can activate his own. Rickets is not found in Uganda. Osteomalacia is absent, the female not being/

being under any restriction such as is found in the purdah custom of India. Marked calcium-phosphorus imbalance seems to be corrected.

PIGMENTS.

Admittedly most of the native dietary is deficient in these, unless spinach is included. The syndrome described by UNDERHILL and MENDEL[31] could easily occur in Uganda, but only a thorough search will enable any definite opinion being arrived at.

ACTUAL CONTENT of CERTAIN STAPLE FOODS.

These were obtained in Buganda Province, and were examined by the Government analyst; they are fairly representative of the varieties eaten by the natives in the writer's district and the figures are recorded below:-

Maize Flour Obtained Locally.	%
Moisture	11.05
Ash	1.25
Digestible Carbohydrates	73.55
Protein (Protein N x 6.25)	14.38
Crude Fibre	2.10
Fat & other ether extractives	3.25
Phosphates as P2 05	0.49
Calcium as Ca 0	0.02

Banana/

Banana Flour Obtained Locally.	%
Moisture	14.25
Ash	2.30
Digestible Carbohydrates	58.10
Protein (Protein N x 6.25)	3.06
Crude Fibre	0.60
Fat and other ether extractives	0.58
Phosphates as P2 05	0.24
Calcium as Ca 0	0.03

Beans (Mutike) Obtained Locally.	
Moisture	11.85
Ash	3.85
Digestible Carbohydrates	30.72
Protein (Protein N x 6.25)	20.31
Crude Fibre	3.49
Fat and other ether extractives	1.18
Phosphates as P2 05	0.84
Calcium as Ca 0	0.11

Groundnuts Obtained Locally.	
Moisture	5.95
Ash	2.95
Digestible Carbohydrates	8.41
Protein (Protein N x 6.25)	22.87
Crude Fibre	2.60
Fat and other ether extractives	49.19
Phosphates as P2 05	1.02
Calcium as Ca 0	0.09

Cassava (Mohogo) Obtained Locally.	
Moisture	57.35
Ash	0.55
Digestible Carbohydrates	32.97
Protein (Protein N x 6.25)	1.50
Crude Fibre	0.90
Fat and other ether extractives	0.40
Phosphates as P2 05	0.17
Calcium as CaO	0.04

Banana/

Banana Obtained Locally.	%
Moisture	66.45
Ash	0.90
Digestible Carbohydrates	25.81
Protein (Protein N x 6.25)	1.87
Crude Fibre	0.28
Fat and other ether extractives	0.16
Phosphates as P2 05	0.11
Calcium as Ca 0	0.02

Sweet Potato Obtained Locally.	
Moisture	58.30
Ash	0.85
Digestible Carbohydrate	33.84
Protein (Protein N x 6.25)	2.50
Crude Fibre	0.94
Fat and other ether extractives	0.17
Phosphates as P2 05	0.22
Calcium as Ca 0	0.03

It is evident that considerable imbalance obtains between the calcium and phosphorus.

In the maize flour phosphorus (as P_2O_5) is to Ca 0 as 24.5 to 1. In banana flour the imbalance is 8 to 1: in beans 7.6 to 1: in groundnuts 11.3 to 1: in cassava (muhogo) 4.25 to 1, i.e. reasonable; in actual bananas 5.5 to 1: in sweet potatoes 7.3 to 1.

As this imbalance is in terms of P_2O_5 and Ca 0, it is not as great as it looks, being considerably less in terms of Ca. and P. It is felt, however, that there is still an imbalance even then, but/

but this is probably adequately dealt with by vitamin D.

It is also noticeable that the protein content of beans is high, being 20.31%; the protein in peanuts amounts to 22.87%. Maize flour shews a satisfactory figure, namely 14.38%, but the disadvantages of zein have already been pointed out. The protein content of the other local examples is unsatisfactory and of these bananas, or plantains, sweet potatoes, and cassava are largely consumed. Nuts and beans are often omitted from the dietary. With regard to cassava, it is often stored as a famine food: it makes very good eating, but the native probably realises its disadvantages. From experience it may be stated that destitute Rwanda are often admitted to hospital suffering from marked nutritional oedema, and they frequently give a history of prolonged and exclusive use of cassava. It is known that nutritional oedema may result from inadequacy of protein, both quantitatively and qualitatively. Such oedema has been found in Uganda to result in ulcers, which frequently become phagoedenic.

Uganda diets are classified, here, according to the protein possibilities, and are designated P/

P + +; P + ±; P +; P ±; P -.

P -	Little, or no, food likely to supply 10% protein.
P ±	Mainly P -, plus occasional beans, peas, nuts, meat or fish.
P +	P ± with nuts and beans more frequently, meat occasionally.
P + ±	P + with beans and nuts frequently. Meat once or twice weekly.
P + +	P + ± with meat twice, thrice or more weekly.

Interrogation of 112 ulcer patients resulted in reasonable information in 52 cases, the others giving unreliable answers.

Of the 52 cases, the classification is as follows:-

P -	16
P ±	17
P +	11
P + ±	8
Total	52

P + + rarely is found in ulcer cases. Examples of P + + will be shewn later.

The/

The calcium and phosphorus figures of ulcer cases with various diets are as follows:-

P -	16 CASES.	
	Ca.	P
5587	9.3	2.3
4462	8.8	3.0
3369	8.8	2.8
3191	8.5	3.5
3166	8.9	2.2
3059	8.6	3.8
1104	8.3	6.0
710	24.1	2.7
4547	7.9	3.3
4183	9.3	3.0
4119	8.8	4.2
1661	5.5	4.5
1319	10.0	2.2
885	6.3	11.2

Average Ca 8.3 P 3.4 Mgs. %

P/

P ±

13 CASES

	Ca.	P
5010	8.5	2.3
2654	9.8	3.5
1487	15.0	3.4
148	11.9	2.0
730	16.1	10.4
784	11.7	4.4
1230	8.1	8.2
2182	8.4	2.4
3898	8.7	4.5
4068	9.4	5.4
4610	9.9	3.5
5139	9.1	4.7
5256	8.9	3.3

Average Ca 10.4 P 4.5 Mgs. %

P/

P +

11 CASES.

	Ca.	P
3558	8.9	3.3
3256	10.0	3.1
2059	10.0	2.6
1901	8.2	5.3
1392	15.0	4.0
576	11.9	2.8
5740	9.3	4.3
3856	8.6	4.0
2708	9.7	4.1
2642	19.0	3.4
809	9.6	2.3

Average Ca 10.9 P 3.6 Mgs. %

P + ±

8 CASES.

	Ca	P
899	8.8	3.0
839	9.4	5.0
5119	8.2	2.7
2147	8.2	1.8
412	11.3	5.7
1464	9.0	3.4
827	7.6	5.6
674	10.7	4.7

Average Ca 9.2 P. 4.0

DISCUSSION.

From the above figures it is impossible to conclude anything. In the P-Group, certainly, the calcium levels are almost all low, and even with number 710 with a calcium figure probably due to protein, the average calcium is only 8.3 mgs. %.

In the P ± Group there are several (4) high figures which raise the average to 10.4; 4 have a normal level, however, and the others are not markedly low. In 11 P + cases there are 3 high figures, but a higher proportion fall within normal limits - actually 5.

In 8 P + ± cases, there is a considerable proportion of low figures.

In short the question is whether or not any reliance is to be placed on the native's statement: it is surprising how often one fails to obtain a direct answer from an African. In the writer's opinion there is no such thing as even a P + ± diet in ulcer cases. If there is, then diet can have very little bearing on the serum calcium, and that is against most findings. The following figures in TABLE 18 may help to shew that in some cases, at least, lengthy dieting may raise the serum calcium. The hospital diet will be shewn later.

TABLE 18/

TABLE 18.

EFFECT of HOSPITAL DIET on the SERUM Ca and P of 10 CASES of ULCER

No.	Initial Ca	P	Diet	Ca	P	Result
929	9.8	3.4	Hospital	9.1	3.4	Fall
5312	11.7	10.7	i.e.	9.3	2.8	Fall
809	8.9	3.7	P + ± to	9.6	2.3	Rise
1079	6.4	7.8	P + +	11.2	3.6	Rise
1661	5.5	4.5		8.6	1.8	Rise
4119	8.8	4.2		8.9	4.6	? Rise
3623	9.1	5.0		10.1	8.1	Rise
5386	8.2	2.8		8.6	2.2	Rise
5740	9.3	4.3		9.4	2.6	? Rise
1791	8.9	1.9		9.3	4.6	Rise
Rise = 60%			Fall = 20%			Doubtful = 20%

20% i.e. 2 cases out of 10 fall after dieting, but one of these was high, and came down to a more likely level.

60% of cases shewed a rise in serum calcium after a considerable period on hospital diet - so much for the natives' statements, as this indicates that diet of a reasonably generous nature raises the calcium, given considerable time. Whatever happens, the calcium figures in ulcer cases are much less constant than those found in normal individuals on a good diet.

As an example of a P + + diet, the diet of Luzira Prison is recorded on p. 141a.

NORMAL DIETS.

1. LUZIRA PRISON.

RATION/

RATION SCALE PER MEAL FOR NATIVES

	Evening Issues for Next Day					Morning Issues for Same Day.					
	M. Meal	Beans	G. Nuts	S. Potatoes	Salt	M. Meal	Beans	G. Nuts	F. Meat	S. Potatoes	Salt
Sun.	7 ozs	2½ ozs	1½ ozs	-	¼ oz.	13 ozs	2½ ozs	1½ ozs	-	-	¼ oz
Mon.	7 "	2½ "	1½ "	-	¼ "	13 "	2½ "	1½ "	10 ozs.	-	¼ "
Tue.	7 "	2½ "	1½ "	-	¼ "	7¾ "	2½ "	1½ "	-	35 ozs	¼ "
Wed.	7 "	2½ "	1½ "	-	¼ "	13 "	2½ "	1½ "	10 "	-	¼ "
Thur.	7 "	2½ "	1½ "	-	¼ "	13 "	2½ "	1½ "	-	-	¼ "
Fri.	7 "	2½ "	1½ "	-	¼ "	13 "	2½ "	1½ "	8 "	-	¼ "
Sat.	7 "	2½ "	1½ "	-	¼ "	7¾ "	2½ "	1½ "	- "	35 ozs	¼ "

Note:- Beans, Ground-Nuts, Sweet Potatoes, and Salt to be issued every evening.

This diet is given to long and short term native prisoners.

The calcium and phosphorus figures have been estimated in 25 convicts. These were all long term cases, who had been in prison for a considerable time, and had thus had opportunity to benefit from a P + + diet.

25 Prisoners on P ++ Diet

		Ca	P
Convict No.	3180	9.8	2.3
" "	3910	10.1	3.5
" "	3279	11.1	2.7
" "	1395	10.7	2.9
" "	2882	11.2	2.8
" "	3189	10.3	3.4
" "	1859	10.8	4.0
" "	4597	11.2	2.3
" "	4598	10.5	5.5
" "	3811	11.5	3.8
" "	3193	10.8	3.8
" "	2883	11.4	2.5
" "	3198	10.9	2.5
" "	4523	8.2	3.7
" "	3197	10.6	2.6
" "	3187	10.9	3.7
" "	2993	11.6	2.1
" "	3199	11.2	3.4
" "	4268	10.9	2.3
" "	3201	11.3	3.4
" "	4040	11.5	1.6
" "	2583	11.1	1.7
" "	3207	11.6	2.5
" "	3861	11.4	2.8
" "	3746	10.3	3.3

DISCUSSION/

DISCUSSION.

With the exception of Convict No. 4523 there is a very marked superiority of level to that obtaining in ulcer cases. 25 convicts chosen at randon produce normal, or slightly above normal, calcium figures, only one being low. The inference is thus that the P + + diet is the only factor producing this satisfactory state.

In the prison diet it will be seen that on Sunday 5.5277 grammes of phosphorus, as P_2O_5, and 0.3926 grammes of Ca. O are obtained, i.e. 7 ozs. maize give Ca O .0474 gms. and P_2O_5 1.1613 grammes; 2½ ozs. of beans give Ca O 0.088 gms. and P_2O_5 0.684 gms; 1½ ozs. of nuts give Ca O 0.043 gms. and P_2O_5 0.48 gms. There is therefore an imbalance of 14 to 1, which, of course, is reducible if in terms of P. and Ca. Vitamin D deals with this.

On Monday, excluding the 10 ozs. of beef (fresh) the phosphorus and calcium intake is similar. Local meat has not been analysed, but it is felt that animals anywhere will have a fairly constant figure, and it is assumed that the Ca varies from 0.005% to 0.016% as obtains elsewhere. The phosphorus varies from 0.097 to 0.323%. Giving the meat the highest

of/

of these figures there would be an additional 0.0512 grammes Ca and 0.77 grms. P. The total intake on Monday would thus be 443.8 milligrammes of calcium oxide and 6.3031 grammes of P_2O_5.

On Tuesday, owing to a large bulk of sweet potato, the total intake of calcium as Ca. O is 695.0 milligrammes and the intake of phosphorus pentoxide is no less than 7.1573 grammes.

The intake on the other days is approximately similar, apart from only 8 ozs. of meat being issued on Fridays.

It is evident that sweet potato in bulk supplies quite a proportion of calcium, but the bulk ingested is less than in the ordinary natives' diet due to there being beans and nuts, and less bulk means more digestion. Under the action of vitamin D, which is presumed adequate, it must be concluded that <u>all</u> the calcium is absorbed, because the calcium figures are satisfactory in the sera of these convicts. The amount of calcium usually stated as being necessary is 1 gramme per diem, which allows a satisfactory margin. In the above diet there is no margin. The imbalance is obviously dealt with. In the event of all the phosphorus being absorbed, excess must be quickly excreted because the phosphorus/

phosphorus content of all sera is normal. (The urine of the native is often alkaline, and contains a fair amount of phosphates).

Apart from meat, the fat consumed daily is not less than 66 grammes on days when no sweet potatoes are issued. On these other days, the fat amounts to not less than 61 grammes. There is extra fat in the meat, and so the fat is adequate.

The protein, apart from the meat, is considerably over the 100 grammes, which is usually considered adequate, and even if the additional meat only contained 15% protein, a very generous allowance is consumed. The prison diet is thus almost entirely sufficient; all that seems necessary is the addition of another half-gramme of calcium to give a margin.

2. KOLOLO LABOUR CAMP

21 labourers were selected. All had a more or less similar diet which, in addition to sweet potatoes, contained cassava, spinach boiled with sim-sim seeds, and meat or fish nearly every day. Each man had been in service for a minimum of one year, but usually nearer five years, and none had been off-duty all the time - in truth, a fit set of natives/

natives.

The first time the estimation was carried out, the bloods were collected between 10 and 11 a.m., the porters commencing work at 7 a.m. No breakfast is taken by these porters.

The results were extremely curious, and are only recorded here as a matter of interest. The calcium and phosphorus levels are so high as to appear impossible, and yet other estimations were being carried out at the same time, with the same reagents, which gave normal results.

A second examination was made a week later, after a small meal at 7 a.m., the bloods being collected between 10 and 11 a.m. On this occasion the calcium figures were much more like normal, although the phosphorus was high. Both results are recorded in TABLE 19.

TABLE/

TABLE 19

Ca and P of 21 Healthy Porters on P + + Diet.

21 Sera 1st Examination			20 Sera 2nd Examination	
Name	Ca	P	Ca	P
Alalido	31.2	17.0	10.9	6.6
Paulo	33.1	?	10.0	17.8
Okwiro	46.0	20.0	9.1	14.0
Senkima	37.9	17.8	13.0	9.0
Lorentio	34.3	20.0	10.8	7.0
Mbadobo	33.4	16.6	12.3	10.5
Mauro	32.2	23.1	11.0	7.7
Fesito	31.5	15.0	11.5	9.4
Oyo	33.2	15.8	11.7	8.9
Antoniyo	29.6	12.0	11.3	8.4
Toyi	34.7	13.7	11.2	12.6
Ourendio	27.9	16.7	*10.7	12.3
Yakobo	34.3	16.1	10.4	13.2
Amandwa	29.5	15.8	*10.3	11.4
Nderabega	33.6	18.7	11.5	9.4
Bundwa	34.8	15.8	11.5	10.9
Lasito	31.0	22.8	12.3	10.4
Firipo	35.7	21.4	11.0	7.0
Matayo	23.4	16.1	-	-
Yokana	37.5	17.6	12.2	8.5
Enosi	39.2	17.8	10.4	11.1

* Different Porters.

DISCUSSION/

DISCUSSION.

The figures for the first examination appear absurd. To state that they are due to calcium alone would simply invite severe criticism. As the sera were not incinerated the high figures may have been due to protein. The only argument against protein is the fact that in such a case one or two only of a batch usually give high figures, but not all of a batch.

The technique may be vouched for apart from the fact that the sera were not ashed. It is the writer's intention to repeat tests on this labour camp:-

(a) by examinations of ashed sera;

(b) if possible, by examination of the cerebrospinal fluid.

The figures in the second instance are still high, though almost normal.

The serum phosphorus is also excessively high, and remains high in the second estimation. These men had been at work in the sun for three hours, and the inorganic phosphate may have increased due to irradiation of the skin. According to GÜNTHER[32] the chief cause of the increased value for whole blood phosphorus/

phosphorus during work is a relative increase in the proportion of red corpuscles. A small rise in serum PO_4 occurs due to concentration. It is impossible to judge if work could have increased the PO_4 to the level found in these porters.

3. MULAGO HOSPITAL.

The ration issued to patients, if allowed full diet, is as follows:-

Daily:-

Sweet potatoes or plantain	8 lbs.
Beans	4 ozs.
Ground Nuts	1 oz.
Salt	½ oz.

Weekly:-

Meat	1 lb.
Fresh vegetables	1 lb.

All articles are weighed uncooked and unpeeled. The meat is without bone, and the one pound weekly means that ¼ lb. is eaten four times weekly, or ½ lb. twice weekly.

This dietary, apart from meat and fresh vegetables (the composition of the latter unknown), gives/

gives the following foodstuff quantities daily:-

Protein (as N x 6.25)	Potato 102 gms.	(Plantain 77. gms.)
	Beans 26 gms.	
	Nuts 7 gms.	

These quantities are approximate, fractions being omitted. If sweet potatoes are eaten, then the total protein is approximately 135 grammes daily. If plantain is eaten (matoke), then the daily amount is about 110 grammes. It would appear that there is sufficient protein, apart from meat and fresh vegetables, but the biological value of the 102 grammes potato protein, and 77 grammes plantain protein are unknown, and may be insufficient. The biological value of the bean and nut protein (total 33 grammes) is probably good, as these are generally considered to give first-class protein.

The meat, even if it only contains 15% protein, will ensure a further 77 grammes weekly, i.e. about 11 grammes daily, of a biologically sound protein.

Fat.

Sweet Potato	8 gms.	(Plantain 8 gms.)
Beans	6 "	
Nuts	16 "	

Apart/

Apart from the meat, which will also supply some fat, the fat is inadequate in amount, being only 30 gms. daily, in round figures.

Calcium and Phosphorus

	Ca	P	(grammes)
Sweet potato	1.23	9.01	"
Matoke	0.82	4.50	"
Beans	0.14	1.06	"
Nuts	0.03	0.27	"
Meat	0.05 ?	1.50 ?	" (weekly)
Fresh vegetables	?	?	

A generous allowance has been made for the meat, which is considered to have 0.016% Ca O and 0.323% P_2O_5. In the event of sweet potatoes being eaten, the daily amount of Ca O, apart from meat and fresh vegetables, is about 1.40 grammes, and the amount of phosphorus, as P_2O_5, is 10.34 grammes. The calcium is thus adequate, but there is a P_2O_5 - Ca O imbalance of 7.4 to 1. This is adequately dealt with by vitamin D, as the patients sit out on the lawns in the sun, and the wards are well lit and glass windows are not closed. Further, it has been indicated previously (cf. p. 140) that the serum calcium improves/

improves with this hospital diet.

During 1932, calcium and phosphorus estimations were carried out on 61 patients. As it was discovered that the bloods were withdrawn at various times of the day, regardless of meals, the results were considered unsuitable for recording from the point of view of serum calcium. It might be of interest to record these figures at this point, as in a number the phosphorus is very high. The proportion of cases shewing a high serum phosphate level is greater than in the fasting cases examined during 1933. It was impossible to ascertain the time at which each blood was obtained, but the higher proportion of raised phosphate cases indicates that this is due to absorption after a meal. The results cannot be compared with those from Kololo Camp, which are far from clear, being only recorded as a matter of interest.

TABLE/

TABLE 20.

Serum Ca and P (mgs. %) of 61 Ulcer Cases examined during 1932, at various times of the day.

LOW Ca			NORMAL Ca			HIGH Ca		
No.	Ca.	P	No.	Ca.	P	No.	Ca	P
1	6.2	18.4	1	9.0	2.4	1	11.7	10.7
2	6.4	12.5	2	9.1	3.4	2	11.7	3.4
3	6.5	10.7	3	9.2	8.0	3	11.7	3.1
4	6.5	22.5	4	9.2	8.1	4	11.7	3.0
5	6.9	16.9	5	9.3	6.3	5	11.8	3.2
6	6.9	14.5	6	9.8	8.2	6	11.9	4.8
7	7.0	18.6	7	10.0	5.0	7	12.0	4.6
8	7.1	20.9	8	10.0	4.6	8	12.0	3.8
9	7.2	13.6	9	10.2	3.2	9	12.0	7.0
10	7.4	10.3	10	11.0	6.3	10	12.1	5.6
11	7.9	4.0	11	11.0	3.5	11	12.2	5.0
12	8.1	13.5	12	11.1	12.5	12	12.3	4.2
13	8.1	6.7	13	11.2	4.0	13	12.3	4.2
14	8.2	6.8	14	11.3	5.7	14	12.3	3.0
15	8.5	13.5				15	12.8	4.0
16	8.5	7.7				16	12.9	2.6
17	8.6	15.1				17	12.9	4.0
18	8.6	9.4				18	13.1	4.3
						19	13.1	13.6
						20	13.3	6.9
						21	13.3	3.1
						22	13.3	5.4
						23	13.5	4.3
						24	13.8	3.6
						25	14.0	13.4
						26	14.3	6.8
						27	14.7	8.8
						28	15.1	5.5
						29	16.8	7.3
Av. Ca 7.5			Av. Ca 10.1			Av. Ca 12.9		
Av. P 13.1			Av. P 5.8			Av. P 5.1		
Proportion Ca			Proportion Ca			Proportion Ca		
Low = 29.5%			Normal = 22.9%			High = 47.5%		

DISCUSSION.

Although the exact times of collection of samples of blood are unknown, it may be assumed that each group (i.e. Ca low, normal, and high) had a similar proportion of cases who had eaten prior to collection. As in the 1933 cases recorded, the calcium levels vary greatly, but there are many with a very high calcium - far more than in the 1933 cases, actually 47.5% as compared with 14%.

The proportion with a calcium falling within normal limits is 22.9% as compared with 56% for the phagoedenic cases of 1933 and 43% for the non-phagoedenic cases.

29.5% of cases shew a low calcium as against 30% phagoedenic and 41% non-phagoedenic cases of 1933.

Although these figures do not correspond to any definite extent, it can still be stated that the calcium of all ulcer cases is much more variable than in normal subjects, the calcium being either markedly low or markedly high, and being normal only in a certain proportion, which varies from 22.9% to 56%. The serum calcium of the convict group stands out markedly as an example of what the normal figure should/

should be, i.e. nearly 100% between 9.5 and 11.5 mgs. percent.

The phosphorus of the 1932 cases differs markedly, and as meals had been consumed by many (actual number uncertain) it is permissible to assume that food had some influence on the results. As probably all three groups included non-fasting cases, one fact at any rate is suggestive, namely that the low calcium cases have a very high phosphorus content, with two or three exceptions only. The phosphorus of the normal, and high calcium cases is not much above normal, considering that a proportion had probably dined. Only one case in the normal group shews a markedly high phosphorus and only 3 high calcium cases have a markedly raised phosphorus.

The calcium in the hospital diet is adequate, although the large bulk of the food may inhibit absorption. The phosphorus must largely be absorbed, as 1933 fasting cases did not shew the high figure seen in the 1932 cases. As the high levels are found in the non-fasting cases with low calcium, it would appear that these cases shew a phosphorus retention. There is a suggestion of reciprocity of Ca and P in these 61 cases. Quantitatively, the protein of the Mulago hospital diet is adequate. Qualitatively/

Qualitatively, there is uncertainty as regards the protein of the potato, and the plantain. The nuts and beans supply only a small amount, but this is probably reliable. Meat, which is of unquestionable value, is often enough included to make the diet classifiable as P + ± or P + +. Without meat, the value of the other articles would be uncertain, as even if the above ration is divided into three meals, the bulk is still considerable, and nitrogen might be lost to the body in spite of much cellulose being softened by cooking.

Considering for a moment the Mulago ration, a fair idea of the usual dietary of the ulcer class may be arrived at. Beans and nuts offer quite a small bulk to the peasant, who is accustomed to accommodating 8-10 lbs. of potatoes daily and not in three divided doses, but as one or at the most two meals per diem. Any omission, such as beans and nuts, is made good by potatoes and plantain or "gonja", a sweet plantain which is baked. The native thus may obtain 100 grammes protein per diem, but in two doses of 50 grammes, which are each sheltered within a bulk of carbohydrate, including cellulose, of 4 or 5 lbs. It seems against all the laws of nature/

nature to expect very much of this protein to be uncovered, and utilised. The same may apply to calcium, but there appears to be a good margin in the ordinary native diet, as compared with that of Luzira prison. The fact that meat is seldom eaten by the lower classes is thus very significant; nuts and beans may help matters by introducing a small quantity of biologically good protein, but the cellulose, etc. still offers a barrier. Why meat is not more often consumed is a mystery. The native markets sell goats' liver at about 20 cents per pound, and mutton and beef for 40 cents per pound. (Ox liver is generally sent to larger markets for sale to Europeans, or a higher price may be asked, as the native knows that it is in demand at hospitals). Without nuts, it is obvious that fat is inadequate in the native dietary. It is also inadequate in the Mulago diet, according to the single analysis of foods quoted above.

4/

4. HOSTEL of the UGANDA MEDICAL SCHOOL, MULAGO.

Weekly ration: food weighed uncooked & unpeeled.

Sweet potatoes	10 lbs.
Matoke	16 "
Beans	2½ "
Ground Nuts	9 ozs.
Rice	3 lbs.
Meat (no bone)	1 lb.
Ghee	8 ozs.
Salt	3½ "
Spinach	5 cents worth
Sugar Cane	5 " "
Gonja	7 fruits

It is impossible to give the total daily quota of foodstuffs, as rice has not been analysed. Apart from rice, 10 lbs. potatoes give 128 grammes of protein; 16 lbs. matoke give 163 grammes approximately; 7 gonja cannot be estimated, as the weight of each fruit varies: 2½ lbs. of beans give about 256 grammes; 9 ozs. of ground nuts give about 70 grammes: 1 lb. of meat gives about 77 grammes. If rice is given a protein value of 8% (its content elsewhere) then 3 lbs. would yield about 123 grammes protein/

protein. The total weekly protein, excluding spinach and gonja, seems to be about 817 grammes, i.e. approximately 116 grammes daily, of which 57 grammes, coming from meat, beans, and nuts, are of first-class value. The remainder is of doubtful value, but complete analysis is necessary before anything can be said.

The ghee (pure fat) gives, alone, 36 grammes fat daily. To this is added 23 grammes from nuts and beans, and so, apart from the small amount obtained from the matoke and potatoes, the fat is quite adequate. Rice would supply more fat; possibly it may contain 6%. In the potatoes, beans, nuts and plantain there is a daily Ca O of 630 milligrammes. There should be enough in the gonja and rice to ensure an adequate margin. There is no question about the adequacy of phosphorus, in any case this is usually in excess. This diet is P + +.

The serum calcium and phosphorus of 8 medical students, from 4th and 5th years, was estimated. The samples were collected at 10 a.m. The students had had breakfast at 7.30 a.m.

8/

8 Medical Students, Ca and P. in Mgs.%

Name	Ca	P
Mahfuth	10.8	2.8
Aboud	10.0	3.5
Banoba	10.0	2.9
Musitwa	9.5	2.3
Musoke	10.5	2.2
Makoro	10.4	2.6
Kalibala	10.0	2.3
Kadama	10.1	2.7

DISCUSSION.

The above are examples of the effect of a good diet on the serum calcium and phosphorus. The diet contains a sufficiency of calcium, and protein and fat. The breakfast has made no difference to the serum phosphorus, which remains normal. These students were all studying hard for term examinations. Ulcers are not seen in these students, unless abrasions, which heal readily; one reason for this is that they only have 2 weeks' holiday per year, and thus do not have sufficient time at home to be undermined by inadequate diet.

5. MAKERERE COLLEGE, KAMPALA.

Students' Weekly Ration:-

Sweet potatoes	11 lbs
Matoke	16 "
Rice	3 "
Beans	3¼ "
Ground Nuts	9 ozs.
Meat	1 lb.
Ghee	8 ozs.
Vegetables	5 cents
Sugar Cane	5 "
Salt	4¼ ozs.
Gonja	7 lbs.

This diet gives 139.5 grammes protein daily. Of this, 63 grammes come from meat, nuts and beans, and thus are presumably first-class. The fat is adequate, especially as 36 grammes daily are of animal origin (ghee).

The calcium is adequate. Apart from rice, meat and spinach, there is a minimum of 830 milligrammes daily.

The serum calcium and phosphorus of 27 2nd and/

and 3rd year students is as follows:-

3rd Year 9 Students, Serum Ca & P in Mgs. %

Name	Ca	P
Newman	9.7	6.3
Mukibi	9.8	4.2
Male	6.9	2.3
Kikwanguyira	10.2	4.5
Matova	9.5	4.1
Kalikwand	10.1	4.0
Mukasa	10.7	4.4
Musoke	10.6	4.2
Zirimu	9.9	3.9

2nd Year

Name	Ca	P
Makumbi	10.7	2.8
Sempa	10.6	4.0
Sajjabi	10.8	2.8
Kiseka	11.0	3.5
Byangwe	10.6	2.7
Katumba ii	10.4	2.2
Lukenge	10.5	2.1
Katumba i	10.3	2.4
Kiimba	9.7	2.6

Mabano/

Name	Ca.	P.
Mabano	9.6	2.6
Lubega i	9.9	2.1
Lubega ii	9.5	2.5
Sabwe	10.7	2.1
Kakoko	10.8	2.4
Genda	10.6	2.3
Butambara	10.3	2.4
Musoke	9.8	2.4

DISCUSSION

The Makerere College diet represents a P ±+ to P ++ diet. With one exception (Male, Ca. 6.9) all serum calcium figures are normal, none being below 9.5 mgs. %. The phosphorus is normal. These students are compelled to lead a very active life, as they are under school régime, and physical training is compulsory every morning as is football most afternoons, except when attending the swimming bath. During the term no ulcers are seen, but as students have one month three times a year on vacation, they return to their homes and revert to the peasant/

peasant diet, unless they are of the well-to-do class. In these cases, ulcers are sometimes seen on return from long vacation. The cause seems dietetic, as students are more liable to trauma during term. Considering all these diets, the most attractive undoubtedly is that of Luzira prison. The bulk is much smaller, and there is a better quality. There is a sufficiency of biologically good protein, and there is more meat than in the other institutional dietaries. The objections are:-

(a) Only 2 meals per diem;

(b) The fat, apart from meat, is vegetable.

(c) The calcium is at a minimum. That all the calcium is constantly absorbed is shewn by the serum calcium levels.

(d) The protein of maize is of questionable value.

The other diets contain less meat. They contain adequate calcium. With the exception of Mulago patients' diet, some fat is of animal origin. Bulkiness is an objection, as both protein and calcium waste may occur.

The calcium and phosphorus of students' sera is satisfactory, and constantly between 9.5 and 11. mgs. %, and phosphate is normal and relatively little/

little affected by meals.

The sera of ulcer cases vary greatly both as regards calcium and phosphate, and in low-calcium cases the phosphate is raised markedly after food. Less variation of phosphate occurs in ulcer cases with a normal or high serum calcium. The hospital diet can raise the serum calcium of ulcer cases, if given over a long period. This has never been found to improve ulcers as do a few calcium injections. From a calcium viewpoint, diet is a prophylactic, but not a therapeutic agent.

The diet of the ulcer class contains protein of a questionable quality, and it is difficult to separate from the excessive bulk of food. Fat is lacking, which may lead to deficient utilisation of calcium. The calcium is probably adequate, but may be adversely affected by the bulk of the ingested food.

SUMMARY/

SUMMARY.

It has been shewn that ulcers fall into three main groups:-

A or non-phagoedenic;

B or spontaneous phagoedenic;

C or phagoedenic ulcers arising as an alteration of A or an almost immediate result of trauma, which may be trivial. These ulcers are non-treponematous, clinically, and bacteriologically, and are not veldt sores. A high proportion of natives have a positive Kahn or Wassermann reaction, and when this occurs in ulcer cases, no apparent benefit results from the administration of specific drugs.

Treatment has been discussed, and magnesium sulphate solution has been found to be the most suitable dressing. Elastic pressure is very useful in oedematous or elephantoid associated conditions. Calcium injections are of benefit in a considerable proportion of cases unlikely to improve on local and dietetic measures. Parathyroid is almost invariably successful in promoting epithelisation, in the absence of fibrosis. The most speedy method of all is curettage and skin-grafting, but this/

this does not obviate the necessity of general treatment.

As regards sex incidence of ulcer, it would appear that females are not quite so susceptible, but it is difficult to arrive at nett figures in the case of female admissions. The rise in ulcer incidence during 1931, which was a bad year for everybody, suggests that ulcer is a result of privation.

In the phagoedenic ulcers, Bacillus fusiformis, alone, or in association with Spironema schaudinni, is so often found as to indicate that the combination is constantly present. On the other hand, these organisms are rarely present in non-phagoedenic ulcers. (The findings of HASSELMANN[33] are different, however, as ulcers of the same type were described by him, and he suggested that these organisms did not play any part in the causation of non-treponematous ulcers in the less tropical parts of America.) The question in the case of phagoedenic ulcers in the tropics is whether or not the fusiform bacillus and spironema are causal. When these organisms are present in other lesions, where there is less doubt as to their pathogenicity, they are quickly killed by arsenic. There is no such result/

result in ulcers in Uganda; thus the organisms may either be arsenic-resistant, which is not the rule for spironemata, or they are not the cause of the acute process. In support of this is the fact that they are not found in the initial vesicles which are so often the start of a spontaneous ulcer. These vesicles may be the result of spontaneous breakdown of devitalised tissues, as similar changes can occur with nutritional oedema; B. fusiformis and Spironema schaudinni may thrive on the necrotic material as true saprophytes. Against this is the fact that many cases of non-phagoedenic ulcer are just as debilitated, and yet show no such organisms, and many phagoedenic cases are not unduly debilitated in appearance, yet shew vesicle-formation and fusiform organisms.

It must be admitted that it is far from easy to dismiss these organisms as saprophytes, and the tendency is to suspect them as being causal; yet a complete chain of evidence has never been established. It is felt by the writer that they are causal, as they are almost constantly associated with a definite clinical condition, whereas, were they saprophytic, they would be constant inhabitants of all ulcers. Whether the bacillus or the spironema/

spironema is the actual cause is not clear. Both are found in various well-known lesions, the bacillus probably more often. Some light might be thrown on this problem were only the exact relationship of both cleared up. Tunnicliffe considered both to be stages in one life cycle. Others consider both to form a symbiosis, in which case it is rather wonderful that they should meet so constantly and in such definite lesions. Smith believed the spironema to be the causal organism, and not the bacillus and his positive results from human inoculation were due to the spironema alone. His positive results suggest pathogenicity, but the culture was not pure. His results were not confirmed by the writer, who inoculated 9 volunteers direct from a typical sore (incidentally the results of L. Patterson were thus not confirmed either).

The whole problem is one of great difficulty, and nothing will ever be completely established until some worker succeeds in obtaining a pure culture and a fair number of human volunteers for inoculation.

It has been shewn that tribes living largely on animal food are relatively ulcer-free, ulcers being the almost exclusive property of the vegetarian/

vegetarian tribes.

This seems to produce at least three factors which can be partially elucidated, although further work is required. These are as follows:-

I. A CALCIUM DEFICIENCY.

Calcium seems to be present in greater amount in vegetables than in the animal tissues usually consumed. There is adequate calcium in most diets discussed, including that of the poor. The diet of Luzira prison contains a minimum, but it appears to be completely absorbed. There is a considerable phosphorus-calcium imbalance in all native diets, but as there is apparently an adequacy of vitamin D, there is no reason to suspect faulty correction, and other evidences of calcium deficiency are lacking. In spite of an apparent sufficiency of calcium, the serum content of ulcer cases is distinctly variable, being mostly low and in a good proportion unduly high, being normal only in from 22.9 to 56% of all cases. The high figures suggest that bone mobilisation may be at work.

The calcium of natives with a good dietary is normal. Their diet is rather less bulky, and contains more easily digested protein. Also in/

in spite of this apparent sufficiency of calcium in even the diet of ulcer cases, injections of calcium improve the ulcers. This suggests:

(a) that calcium is being passed through the alimentary tract unabsorbed, due to the large bulk of vegetable matter, which both hastens peristalsis, and shelters calcium from the digestive juices;

(b) that a load is being removed from the parathyroid by the direct introduction of ionised calcium into the blood stream.

It has been stated that there is reason to believe that the parathyroid is either deficient, or otherwise engaged, because oral administration of dried extract in addition to intravenous calcium produces an additional stimulus to healing. The active principle is absorbed by the alimentary tract* in the case of the native at any rate, if given on an empty stomach. The alimentary tract of the native may be less destructive to the extract than that of the European. Because the calcium is adequate in the food analysed, it does not follow that it is equally so elsewhere, as ulcer cases in Loewenthal's district responded much more rapidly to calcium. It appears that calcium is absorbed from the diet of the/

*In addition to the findings of Scott, who used oral parathyroid to enhance the utilisation of calcium in sprue, COLLIP[35] stated that his "parathormone" is effective orally as well as by injection.

the well-to-do (P + ± or P + +) but may escape absorption in the bulky and almost completely vegetarian diet of the poor.

II PROTEIN.

It has been shewn that the diets of institutions (and of the well-to-do) have a certain amount of protein which can be at once guaranteed. This comes from meat, nuts and beans. The diet of the poor contains protein which is open to question until analysis proves it satisfactory. In addition, the large bulk of food ingested by these people does not favour optimum digestion and absorption; in fact the quantity ingested could almost be considered incredible. The absence of ulcers in meat-eating tribes, such as the Masai, strongly indicates that meat is the only source of sound protein, as the protein of nuts and beans is only utilised if it is adequately unmasked. The importance of meat as a source of protein cannot be questioned, and the nutritional oedema, anaemia, weakness, and gastro-intestinal disturbances, occurring in Poland during the war, were a result of a meatless diet. The insufficiency of biologically good protein may affect the parathyroid. The gland certainly is connected with/

with nitrogenous metabolism in some way, and its deficiency might explain the unsteady serum calcium found in ulcer cases. In the absence of definite proof, these possibilities can only be suggested, but inadequate protein of good biological value is known to damage other endocrines - as, for instance, the pituitary; growth does not take place in the absence of lysine. What is true of one gland may be true in the case of others also.

III. FAT.

This is sufficient in most of the good diets discussed, but deficient in the purely vegetable diet of the poor. A source of energy is thus lacking, and more use is made of carbohydrate. Calcium may be less thoroughly utilised when fat is deficient.

It has been shewn that parasitic infection, malarial and helminthic, is an almost constant feature in natives of all classes. It is easy to see that the threshold to disease is lowered, and those with a high protein diet will be more happily situated than those whose diet is poor.

The high incidence of ulcers in children appears at first sight to upset dietary deficiency theories/

theories; children of reasonably good class often have ulcers, and their calcium is similar to that found in other adult ulcer cases. These children usually seem to be given meat about once weekly, and thus appear at first to have a better diet than the poorer classes. It is obvious, however, that the metabolic, and calorific requirements of children are greater than in adults, and as growth is going on, sound protein is absolutely necessary; probably more meat is necessary than they consume. They do not obtain milk with any degree of frequency.

It is also evident that the various vitamins are adequate, and no signs of vitamin D deficiency exist. Lack of vitamin A gives rise to xerophthalmia in Uganda, as elsewhere, and to a cutaneous syndrome which is not related to ulcer. These syndromata are usually only found in institutions; the affected people are otherwise fit and never suffer from ulcer.

CONCLUSIONS.

I. The exact relationship of Bacillus fusiformis and Spironema to Ulcus tropicum remains unproved, but the evidence suggests that these organisms are causal.

II. Ulcer, whatever the clinical type, is a physical sign, and is of much greater significance than the one or two page description, usually given in books, would indicate.

III. Ulcer is a class disease, and is not found among the better classes or in institutions.

IV. Ulcer seems to be closely related to calcium and/or parathyroid deficiency, and may be a manifestation of latent tetany.

V. The calcium deficiency does not appear to be <u>in</u> the diet, but seems to be <u>due</u> to the diet, faulty absorption probably being a factor.

VI. The exact connection of the parathyroid with the condition is not clear, but the gland appears to have factors controlling calcium regulation and skin vitality and resistance, and it may be affected by dietary deficiency.

VII. One of the most important considerations is the quality of the protein in the diet. Ulcers are much more common in vegetarians than in those who include animal substance in their diet. It is essential that a fair proportion of the protein should be of animal origin, as even nuts and beans have the disadvantage of being covered with resistant fibre.

VIII/

VIII. The vegetarian diet, as consumed by the African native, is much too bulky. Digestion of protein, fat and calcium may be greatly interfered with. The most important prophylactic measure, which would go far to prevent the appearance of the ulcer syndrome, is to include meat, eggs, fish, or fowl in the diet, and to reduce the amount of vegetable matter; the consumption of three smaller meals instead of two larger, would favour optimal utilisation.

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